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CONTENTS

- A New Development in Ocean Wave Research:
H. R. Seiwell and George P. Wadsworth 271

- Comparative Electron and Light Microscopic Investigations of Tactoid Structures in V_2O_5 -sols:
John H. L. Watson, Wilfried Heller, and Wesley Wojtowicz 274

Technical Papers

- Alleviation of Experimental Diabetes in Man by Administration of Reduced Glutathione (GSH): Metabolic Implications:
Jerome W. Conn, Lawrence H. Louis, and Margaret W. Johnston 279
- Production of Acute Gouty Arthritis by Adrenocorticotropin: *Leon Hellman* 280
- A Simple Method for Welding Thermocouples:
James A. Riley 281
- Secretion of Radioactive Calcium in the Hen's Egg: *C. L. Comar and J. Clyde Driggers* 282
- Statistical Data on Glacial Boulders:
Gerald A. Waring 283
- Characteristics of the Desoxycholate-treated Cytochrome Oxidase: *S. J. Cooperstein, B. Eichel, and W. W. Waino* 284
- The Analgesic Action of Teroplerin:
Donald Slaughter 286

- Flow in a Thin Glass Capillary as Affected by Wetting the Exterior of the Capillary:
J. C. Henniker and J. W. McBain 286
- Paper Chromatography of Flavonoid Pigments:
Simon H. Wender and Thomas B. Gage 287
- The Inhibitory Role of "Motor" Nerves:
A. R. McIntyre and A. L. Bennett 289

Comments and Communications

- Cultural and Scientific Conference for World Peace; Terminology for Sedimentation Force in Centrifugation; Scientific Method and Social Problems; Colloidal Electrolytes 290

Book Reviews

- The chemistry of high polymers:
C. E. H. Bawn.
Reviewed by *Turner Alfrey, Jr.* 292
- Les richesses de la mer: Noël Boudarel.
Reviewed by *Lorus J. and Margery J. Milne* 292
- Psychology: William James.
Reviewed by *Walter R. Miles* 293
- Organic reactions, IV: Roger Adams. Ed.-in-Chief.) Reviewed by *Everett S. Wallis* 293

Scientific Book Register

Association Affairs

- Southwestern Division, AAAS 294

News and Notes

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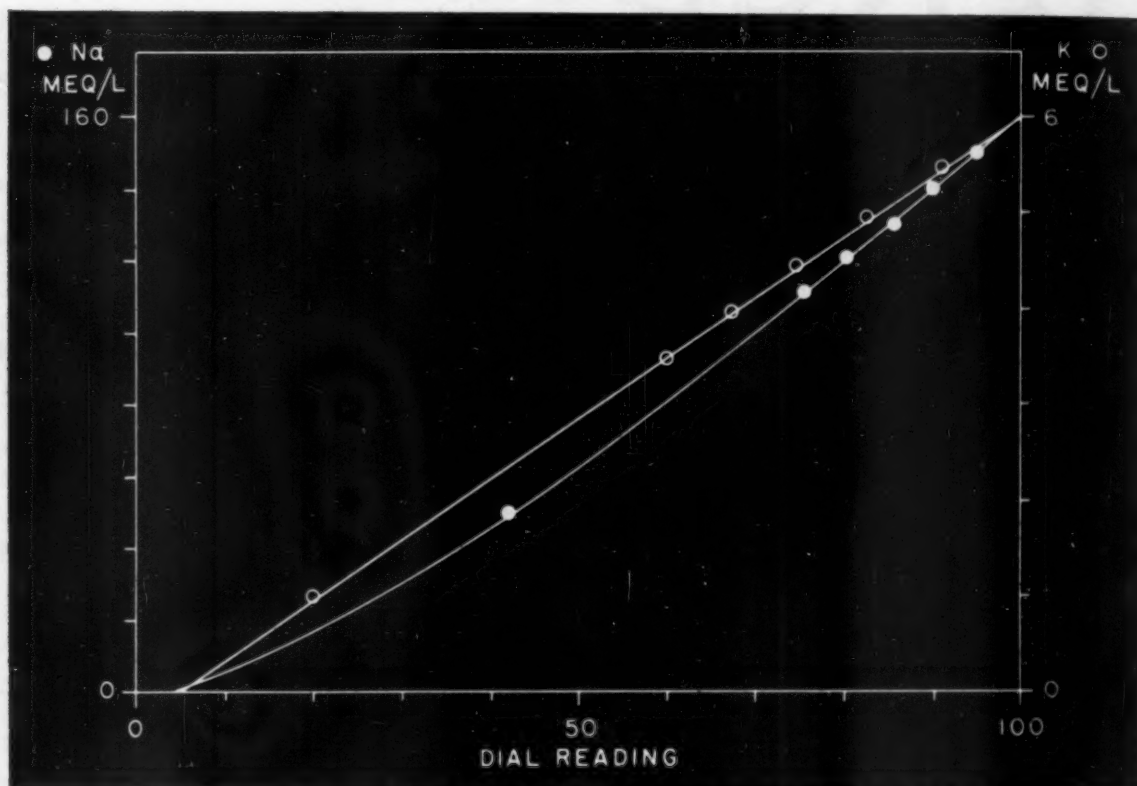
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Typical flame photometer calibration curves for sodium and potassium analysis in blood sera.
Na dilutions 1 to 100; K dilutions 1 to 20

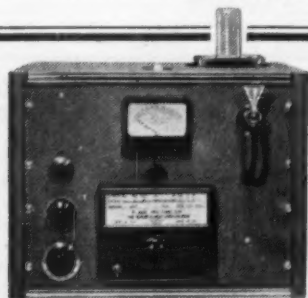
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Analysis	#1		#2		#3	
	Na MEQ/L	K MEQ/L	Na MEQ/L	K MEQ/L	Na MEQ/L	K MEQ/L
1	151.5	4.91	146.9	4.42	146.2	5.50
2	152.0	4.95	147.8	4.41	146.2	5.47
3	150.4	4.88	148.2	4.37	147.5	5.40

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A New Development in Ocean Wave Research¹

H. R. Seiwell and George P. Wadsworth

Woods Hole Oceanographic Institution and Massachusetts Institute of Technology

APPPLICATION OF THE PRINCIPLES of generalized harmonic analysis to oceanic wave observations is here briefly reported. This type of analysis is new to oceanography and has rarely been used in other geophysical practices (2, 3). In our case it was applied initially to observed oceanic wave data as a means of overcoming ambiguities and uncertainties arising from the fitting of Fourier series and from apparent misleading indications of periods from periodogram analyses of finite amounts of data.

The hypothesis of generalized harmonic analysis provides a realistic approach to the subject of oceanic wave investigations. As will be shown, the outcome of the applications far exceeded initial expectations. The results obtained identify the method as a powerful tool for this type of investigation and, provided the hypothesis is applicable to the problem, it serves two distinct purposes:

- (1) To separate the dynamic and random components of oceanic wave patterns, and to evaluate the physical characteristics of each.
- (2) To employ the above results in investigations of the corresponding properties of the physical generating mechanisms.

The dynamic components of ocean wave patterns are presumed to be those generated by systematic action of winds on the sea surface. On the other hand, random components result from variables not considered, such as random motions of the water and local intermittent wind action. Separation of dynamic and random effects in this sense is paralleled in electrical communication, wherein the initial signal frequency is distorted to a varying degree, and distortion of a purely random nature is called noise. On arrival, a message contains the original signal frequency plus a random noise, and the problem is to isolate the initial signal from the message. The analogy to be drawn for ocean waves is that the ocean wave record is comparable to the message, the dynamic portion of the record to the signal, and the superimposed randomness to the noise.

The oceanic wave observations subjected to analyses were obtained in the usual manner, by photographic

recordings of sea surface wave heights and by automatic recordings of wave pressure variations at the sea bottom (1). Such observations comprise geophysical time series from which discrete values of wave heights are scaled at equidistant (1 second) time intervals. Sequences of values so obtained contain certain inherent dynamic properties, together with certain superimposed random components.

Separation of the dynamic and random components and evaluation of their cyclical and oscillatory characteristics are possible by the hypothesis of generalized harmonic analysis. In this manner we eliminate the objectionable a priori assumptions of Fourier series applications to geophysical time series, and obtain results of dynamic significance. Thus, application of the Fourier series to a finite stationary time series permits representation by an infinite number of sums of sine waves of different periods and amplitudes, whereas the correlogram of generalized harmonic analysis is, like the original series, the sum of a series of harmonics with different coefficients, all in phase. The correlogram brings to light a more realistic and more simplified picture of the physical characteristics of the sea surface pattern. The nature of this information is briefly discussed in connection with an analysis of Wave Record 53-X.

A detailed report by the authors on the method of generalized harmonic analysis, together with a rigorous mathematical treatment of the specific applications and representative examples, will be published shortly. Essentially, the method consists of analyzing the correlogram of auto and cross correlations of the data. Thus, as an example, in the series

$$u(t) = A_1 \sin(\lambda_1 t + \alpha_1) + A_2 \sin(\lambda_2 t + \alpha_2) + \dots + A_m \sin(\lambda_m t + \alpha_m),$$

the variance is

$$\lim_{h \rightarrow \infty} \frac{1}{2h} \int_{-h}^h u^2(t) dt = \frac{1}{2} \sum (A_j^2),$$

and the auto correlation function is

$$r(k) = \frac{\sum \{A_j^2 \cos(\lambda_j k)\}}{\sum \{H_j^2\}}.$$

Record 53-X (Fig. 1) designates a 20-min underwater (70' depth) pressure record from a location one and one quarter miles south of Cuttyhunk Island, Massachusetts, beginning at 0650, September 15, 1946.

¹Contribution No. 461 from the Woods Hole Oceanographic Institution and the Department of Mathematics, Massachusetts Institute of Technology.

Previous periodogram analysis of this data, by means of the wave frequency analyzer in use at this Institution (1), produced the result illustrated in Fig. 2. The periodogram is a complicated picture with numerous periods. This represents the customary type of

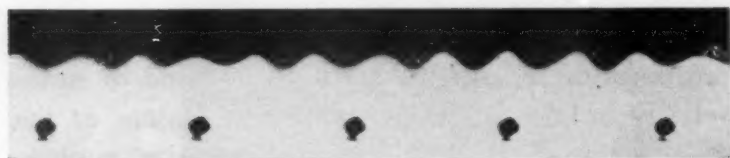


FIG. 1. Portion of Wave Record 53-X. On the original record the upper 30-sec time marks are approximately $1\frac{3}{4}$ " apart.

oceanic wave record analysis, and in the usual interpretation, two distinct frequency bands would be defined as characterizing the data. The first, not too well represented, lies between 6.5 and 8.00 seconds, and the second, well-defined, between 10.5 and 16.0 seconds. Maximum peaking occurs at 12.5 seconds, with two additional, well defined peaks at 11.5 and 15.0 seconds. Hence, the usual conclusions drawn from this analysis would be that the sea surface roughness pattern consists of two defined spectral bands with a dominating period in the vicinity of 12.5 seconds.

Although conclusions like these are not readily disproved, the accepted explanations of geophysical phe-

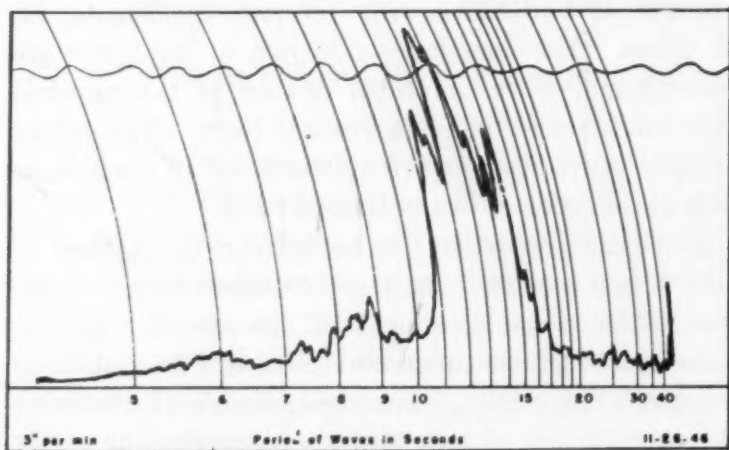


FIG. 2. Results of periodogram analysis of Wave Record 53-X, as given by the wave frequency analyzer.

nomena are those that provide the most realistic and simplified hypothesis. In this case, the fallacy in the analysis appears to lie in the fact that the large number of periods shown for consideration is misleading. The mere fact that the data can be mathematically represented in this fashion does not lend significance to any identical period or group of periods. The component periods are not identifiable, and the period bands which may be construed as constituting the oceanic wave pattern do not possess a realistic physical significance. Rather, this type of analysis suggests that the large number of periods in the periodogram may be indicative of some one disturbed period

in the series. Thus, it can be demonstrated by a generalized harmonic analysis of the original record (53-X) that the wave pattern is not an interference pattern composed of the numerous periods of Fig. 2, but one that is apparently controlled by a single

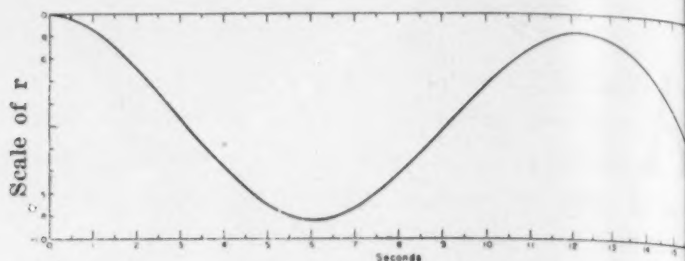


FIG. 3. Correlogram of Wave Record 53-X; 0- to 16-sec lags.

eyclical component on which is superimposed an oscillatory component of the same frequency. Combination of the two components results in the apparent complex basic wave pattern of the record (Fig. 1). This latter, and more realistic explanation, has been derived for Record 53-X in the following manner.

Correlograms of Wave Record 53-X for lag correlations of 0 to 16 seconds, 100 to 111 seconds, and 200 to 211 seconds are illustrated by Figs. 3 and 4. The sinusoidal symmetry of the curves and the time locations of valleys (6.13, 104.13, 202.13 seconds) and crests (12.25, 110.25, 208.25 seconds) indicate a persistent period very near to 12.25 seconds. The variance of the primary data is 0.1824 ft^2 .

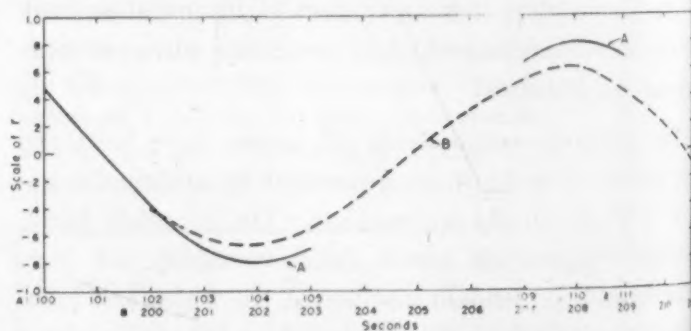


FIG. 4. Sections of correlogram of Wave Record 53-X for the 100- to 111-sec and 200- to 211-sec lags.

The correlogram damps slowly. At the 202nd lag the wave valley has an amplitude of $r_k = 0.66$, and near the 208th lag the crest amplitude is $r_k = 0.62$. The slight asymmetry appears to result from small errors in estimation of the mean value. The mean amplitude for the 16th cycle is taken as $r_k = 0.64$.

In the case where the series consists of a sine term, $A \sin \theta t$, plus a random residual, we have as a theoretical value of the terminal amplitude of the correlogram

$$r_k = \frac{\text{variance cosine}}{\text{total variance}} = \frac{A^2 \cos \theta k}{2\sigma_y^2}.$$

Thus,

$$A = \sqrt{2} \sqrt{r_k} \sigma_y.$$

If the value of $r_k = 0.64$ and that for the variance of the primary data (0.1824 ft^2) is substituted, the theoretical amplitude (A) of the 12.25-second cyclical component in Wave Record 53-X is computed to be: $A = 0.49 \text{ ft}$.

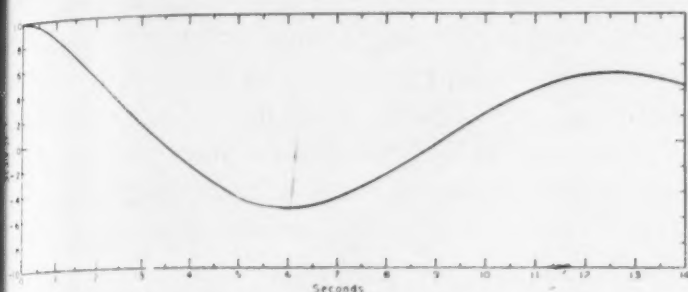


FIG. 5. Correlogram of residuals of Wave Record 53-X; 0- to 14-sec lags.

This value is in close agreement with the amplitude of 0.54 ft computed for the 12.25-second cyclical component by a least-squares fit of Fourier series to the primary data of 53-X. Subtracting this cyclical component from the primary data and computing the autocorrelation functions of the residuals, we obtain the correlogram of Fig. 5. The correlogram damps rapidly to an amplitude of $r = 0.54$ at the end of the first cycle, and thereafter continues to damp. The variance of the residuals is 0.0636 ft^2 .

Substituting above values in the relation

$$\frac{\text{variance of residuals}}{\text{variance of primary data}} = 1 - r_k$$

where r_k is the terminal amplitude of the primary correlogram, we obtain $r_k = 0.656$; a value in good agreement with that of $r_k = 0.64$ for the terminal amplitude of the correlogram of the primary data (Fig. 4).

We may now proceed on the basis that, after extraction of the cyclical component from a finite amount of primary data, the residuals represent the autoregressive part of the primary data. Hence, the total or primary data may be considered to consist of a cyclical component and an oscillatory component, the latter of which is autoregressive. The correlogram of the residuals has a period of 12.25 seconds, identical with that for the primary data. From the Fourier transform of the autocorrelation coefficient, the intensity (S^2) in the periodogram of the residual series is computed. Fig. 6 illustrates the results which show that the energy of this spectrum attains its maximum value ($S^2 = 7.2$) at about 12.25 seconds.

Further numerical computation provides items of verification interest. Thus, multiplying the residual variance by the maximum intensity of the periodogram (Fig. 6) we obtain $A = 0.67 \text{ ft}$ as the theoretical amplitude of the oscillatory component.

The total amplitude of the sea surface oscillation

(C) may now be computed as the square root of the sum of the squares of the cyclical and oscillatory component amplitudes. Thus

$$c = \sqrt{(0.54)^2 + (0.67)^2} = 0.86 \text{ ft.}$$

The mean deviation of the primary data is 0.362 ft; that for the residuals, after subtraction of the cyclical component, is 0.194 ft. Thus, the ratios of mean deviation to standard deviation for each case is: primary data = 0.84 and residuals = 0.77; or the mean deviation is approximately $\sqrt{2/\pi}$ of the standard deviation, a relationship which holds approximately for unimodal curves approaching symmetry.

Application of the hypothesis of generalized harmonic analysis permits the following geophysical interpretation of Wave Record 53-X. The wave pattern represented consists of a well-developed cyclical component (12.25-second period) on which is superimposed an oscillatory component of the same period. The former, which accounts for approximately 64 percent of the sea surface roughness, proceeds through the data as the predictable component, that is, as long as the generating mechanism remains unchanged. The oscillatory component represents the autoregressive part of the data. The cyclical component is presumed to be generated by a prominent oceanic meteorological situation, and the superimposed oscillatory component from local winds and other local disturb-

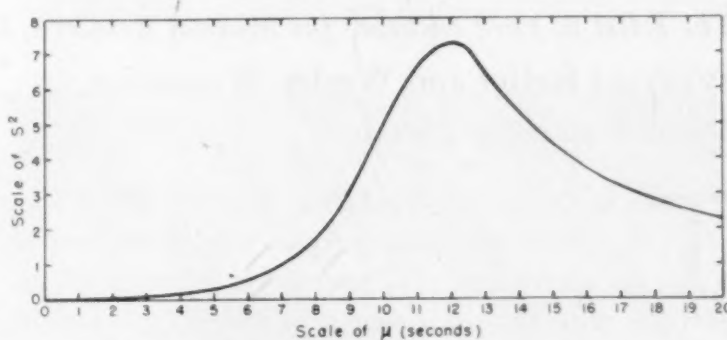


FIG. 6. Energy distribution (S^2) in periodogram of the residual services obtained from the Fourier transform of the autocorrelation coefficient.

ances which tend to change the basic wave pattern. The cyclical is the dynamic component, whereas the oscillatory component is random, although it may possess dynamic characteristics.

Most of the wave records² analyzed to date conform to the general pattern of Record 53-X; that is, a well developed cyclical component on which is superimposed an oscillatory component, plus, possibly, other random factors. In a few instances, the cyclical component has been absent, or so weakly developed as to be indistinct. In rare cases, two distinct cyclical components were evaluated from the primary data.

² These records comprise both sea surface and sea bottom observations. For observing methods see reference 1.

The conclusions to be drawn from the foregoing analyses may be summarized briefly as follows:

(1) Periodogram analyses performed on oceanic wave records do not appear to give correct geophysical information. The numerous wave periods, and bands of periods, indicated by this type of analysis do not necessarily possess physical significance.

(2) Application of the hypothesis of generalized harmonic analyses to western North Atlantic wave records indicates that ocean wave patterns are not complex interference patterns resulting from combinations of many wave frequencies, but frequently consist of a single sinusoidal wave on which is superimposed an oscillatory component.

(3) The cyclical component appears to be that generated under the influence of a dominating oceanic meteorological situation, and the oscillatory component by local winds and other local disturbances tending to change the basic ocean wave pattern.

(4) Separation of the cyclical and oscillatory components and determination of their physical properties is possible by generalized harmonic analysis of finite portions of the primary data.

(5) In the case of Record 53-X, the wave pattern is indicated to be composed of a cyclical and an oscillatory component. The former proceeds throughout the data in regular sinusoidal fashion with an amplitude of 0.54 ft and accounts for approximately 64 percent of the variability in the wave pattern. The oscillatory component, with a theoretical amplitude of 0.67 ft is autoregressive, and strongly damped.

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Comparative Electron and Light Microscopic Investigations of Tactoid Structures in V_2O_5 -sols

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Wilfried Heller and Wesley Wojtowicz,

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THE SPINDLE-SHAPED TACTOIDS in Fig. 1, whose biological interest was recognized at an early date (2), have been investigated repeatedly with the polarizing microscope (15) and by X-rays (1). Electron microscopy has not been applied extensively to tactoids, although it has been used by various authors to study aqueous dispersions of tobacco mosaic virus (10) and of V_2O_5 (3), in both of which tactoids do form under suitable conditions.

In this investigation we studied the development and transformations with time of tactoid structures in a 2% V_2O_5 -sol prepared according to the recipe of Zoher and Jacobsohn (15). Immediately after preparation a solution of this concentration shows a fine particle dispersion in the electron microscope, without structure or apparent orientation (Fig. 2). These colloidal particles have a mean diameter less than 50 Å. In the polarizing microscope a solution of this concentration is optically empty.

In a liquid medium, structures of low rigidity are liable to deform and alter during the drying of speci-



FIG. 1. Photomicrograph between crossed nicols of V_2O_5 tactoids, $\times 100$.

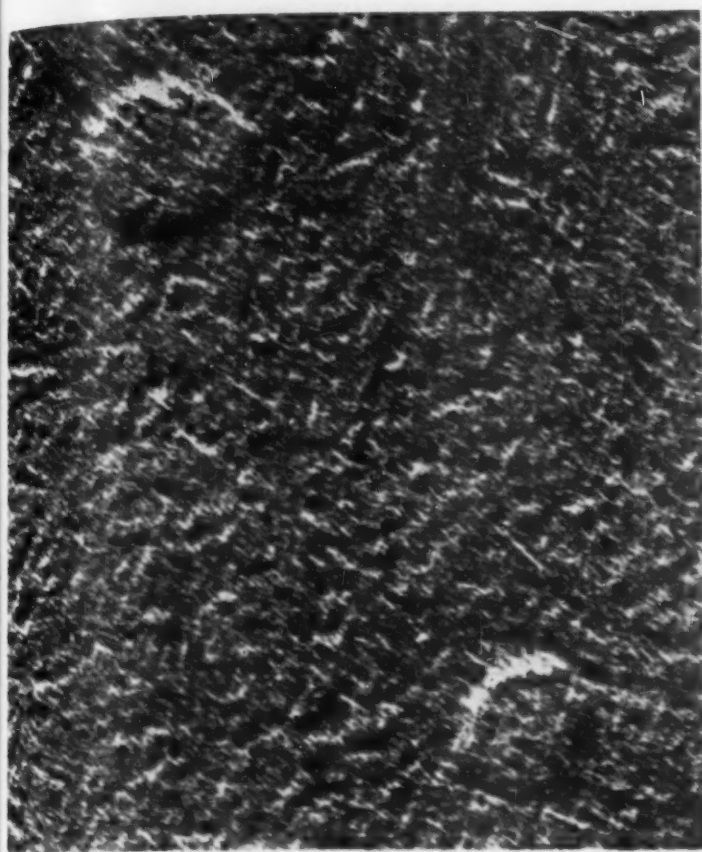


FIG. 2. Electron micrograph of a shadow-cast specimen of a three-hour sample of V_2O_5 , showing fine particulate material, $\times 42,500$.

mens preliminary to electron microscopy, so that structural details can be produced which are absent in the original specimen. In the present work with V_2O_5 -sols an entire drop-let of specimen apparently acquires the consistency of a gel at some period prior to complete drying. This is true only of the older samples, however, and not at all of the freshly prepared ones. As long as one is aware of the possibility of drying artifacts, as well as of other inherent characteristics of electron microscopy techniques, pseudostructures are not a serious drawback but may have real value and give much additional information. In order to get a more complete conception of the properties of a material, the electron microscope should be used in con-

junction with other instruments. In the present work, because of the orientation which exists in the materials, the polarizing microscope has been chosen as a second instrument to aid in interpretation. The polarizing light microscope in many cases defines the spatial arrangement of structural elements, although these elements may have dimensions far below the resolving power of the microscope itself.

Electron micrographs of a dried 24-hour specimen show up the presence of tactoids (Figs. 3 and 4). Shadow-casting at very acute angles and stereoscopic electron microscopy reveal that the dried tactoids have exceedingly little thickness and are almost in the same plane as the film and the background gel throughout. In drying, the spindle-shaped bundle of rods collapses upon itself but retains the general outline of the tactoid. At this and at later stages, sheaves of rods also appear. With the polarizing microscope, solutions are observed to develop individual tactoids with time and complex, anisotropic structures after the aged solution has separated extensively into a lower gel-phase (tactophase) and a supernatant sol-phase (actophase) (15). The primary and probably significant variable during this aging process is the increase in size of the individual V_2O_5 crystals (flat orthorhombic rods) which form the elements of all anisotropic structures. This steady increase in size follows not only from electron microscopy evidence but also from a continuous increase with time of both



FIG. 3. Electron micrograph of a 24-hour sample of V_2O_5 , showing positive tactoids, $\times 5,000$.

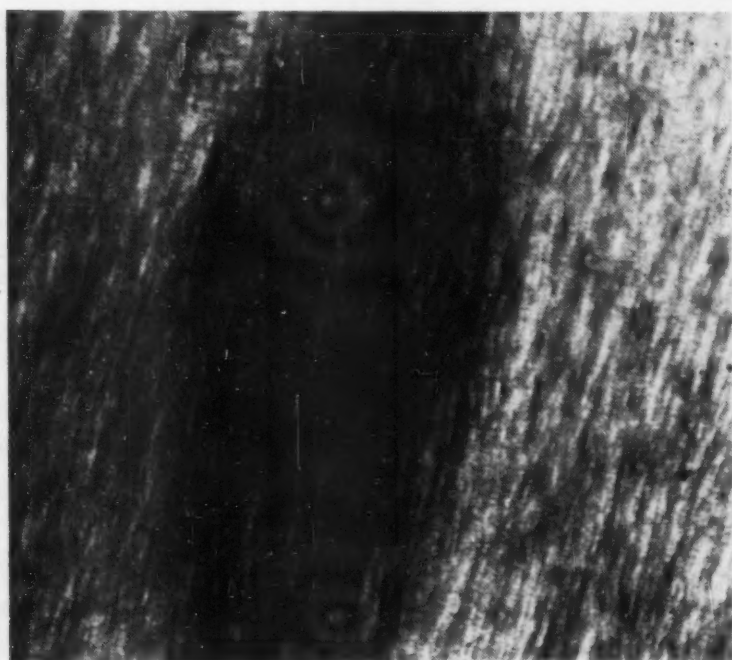


FIG. 4. Electron micrograph of a specimen of a 24-hour sample of V_2O_5 tactoid, taken at higher magnification to show directly the structure of and orientation within a dried, positive tactoid, $\times 24,000$.

magnetic and streaming double refraction in dilute solutions free from structures (6), and from thorough X-ray optical investigations (8), pertinent results of which are summarized in Table 1.

TABLE 1
DIMENSIONS OF V_2O_5 CRYSTALS IN COLLOIDAL SOLUTION*

Age of V_2O_5 -sol	c (in Angstrom units)	b	a
Fresh	50	10	10
2 weeks old	150	20	10
20 years old	1000	100	30

* Results by Ketelaar (8).

The electron diffraction patterns in Fig. 5 verify the crystalline growth for the solutions considered here. The patterns taken over the growth interval

are characteristic of V_2O_5 in all cases: bright but broad lines from the early, particulate material (Fig. 5A), an oriented fiber pattern from the 24-hour specimen (Fig. 5B), and sharp, bright lines from a six-day specimen (Fig. 5C). The decrease in line broadening is very pronounced over this short interval.

The quantitative change in chromatic polarization from the center towards the periphery of the original tactoids, observed with the aid of auxiliary double refraction, proves that they are prolate spheroids prior to being dried out. What the electron microscope shows, therefore, is tactoids which have collapsed onto the supporting film, under maintenance of the nematic symmetry of orientation of the tactoid elements (Fig. 4). This drastic reduction in the thickness of tactoids during drying is proof, in addition to ultramicroscopic (15) and interference optical (4) evidence available, that the mutually oriented elements of tactoids maintain remarkably large, long-range equilibrium distances in the aqueous medium. A preservation of the mutual orientation in dried specimens is also indicated by the fact that electron diffraction yields distinct fiber diagrams. Fig. 4 shows the orientation of rods with their long axis parallel to the long axis of the spindle and the preservation of this orientation.

Fig. 3 and particularly Fig. 4 show variations in density across the images of dried tactoids which may be due to local coagulation of the rods into larger bundles while the tactoid is drying. On the other hand, ultramicroscopy and particularly X-ray analysis have indicated that the internal density of the original spindle-shaped tactoids is fairly uniform.

Occasionally sheaves of rods are found in electron micrographs of the dried specimens along with or instead of the tactoids. Apparently connected with this is the frequently stratified aspect of the back-

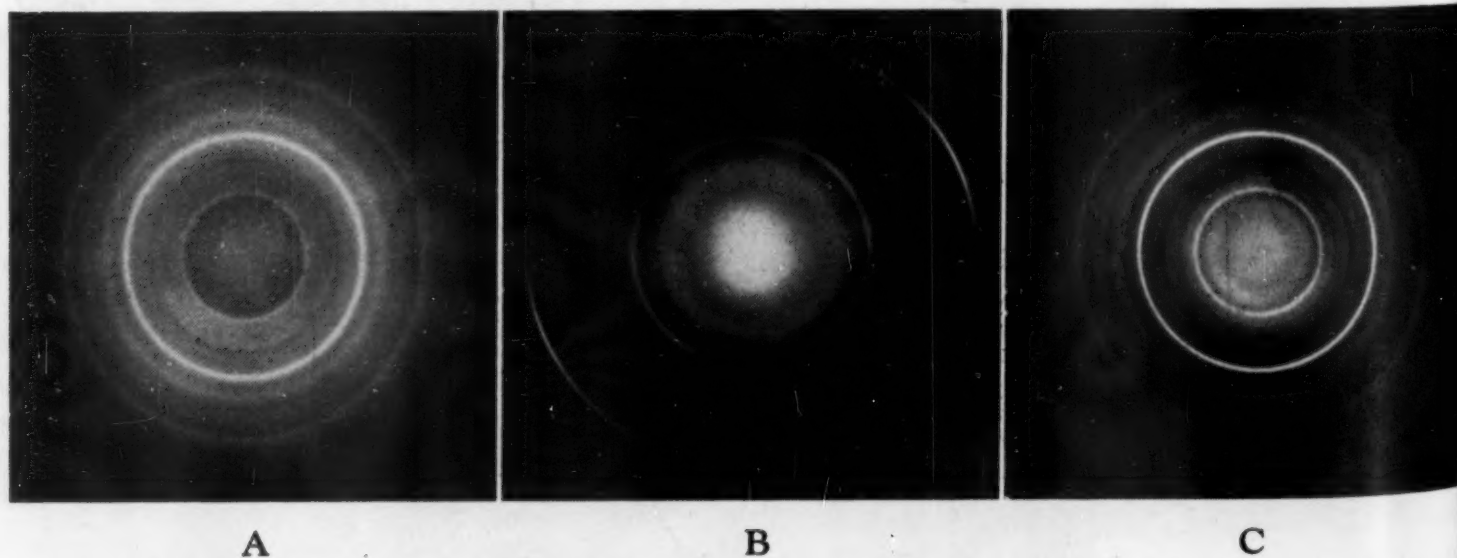


FIG. 5. Electron diffraction patterns of V_2O_5 : A—three-hour specimen, diffuse, broad lines; B—24-hour specimen, preferred orientation; and C—six-day sample, sharp crystal reflections.

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FIG. 6. Electron micrograph of a 72-hour specimen of V_2O_5 , showing negative tactoids, $\times 28,000$.

ground which can be recognized in Fig. 2 despite the low magnification used. Such sheaves are observed also in electron micrographs obtained from the fresh juice of tobacco plants infected with tobacco mosaic virus (7, 13). The polarizing microscope has shown corresponding structures in original undried speci-

TABLE 2

AXIAL RATIOS OF POSITIVE AND NEGATIVE TACTOIDS
(From electron micrographs)

Type	Number measured	Range of the major axis in microns	a/b
positive	27	2.2 to 14.0	5.91 to 2.75
negative	6	0.2 to 0.6	4.0 to 1.6

mens only if typical tactoids fail to develop. Such sheaves of tactosol do not have a well-defined boundary towards the atactosol, but they generally extend over areas at least the order of magnitude of normal tactoids. These sheaves may be structural intermediates between typical tactoids and the structures to be discussed presently.

Wyckoff (14), working with purified tobacco mosaic virus protein, shows gold shadow-cast electron micrographs of frozen-dried specimens in which sheaf formation and stratified background are indicated

somewhat similarly. The meshes observed in frozen, dried preparations were interpreted as negative tactoids (see below); but discrete, positive tactoids, which are illustrated in the present work, were not observed.

Forty-eight hours after preparation extensive anisotropic regions of tactosol are observed in the light microscope, interspersed with elliptical holes filled with atactosol. These holes, first observed by Zoehrer and Jacobsohn and named "negative" tactoids (1) are preserved during drying of the specimens (Fig. 6). The range of their axial ratios is similar to but less than that of the "positive" tactoids as shown in Table 2.

Prior to drying, these anisotropic structures are characterized under the polarizing microscope by a parallel orientation of the individual crystals with respect to the differential symmetry axis of the volume element. In contradistinction to a positive tactoid, there is no symmetry axis for the entire structure. Instead, the differential symmetry axis curves or suddenly changes direction. Except for minor artifacts and structural distortions, the electron micrograph is in agreement with the evidence obtained from double refraction. The electron micrograph clearly shows a transition of the tactosol towards a curving and occasionally interlacing fibrous structure. At the higher magnification of $\times 120,000$ it is found that the individual fibers have a width of 65 Å or less. Such fiber structures of V_2O_5 exhibit a positive double refraction, and since the individual crystals also exhibit this, it follows that the fibers must have a nematic structure.

This trend towards a fibrous structure is accentuated with further aging, as is shown in electron micro-



FIG. 7. Electron micrograph of a shadow-cast, 30-day sample, which shows the transverse structure in the rod-like crystals, $\times 120,000$.

graphs obtained from the tactophase after aging for 30 days (Fig. 7). The equivalent in the polarizing microscope is a mosaic pattern of birefringent areas whose size is below the resolving power of the microscope. The electron micrographs agree with this basic type of structure in the sol.

As to the other interesting details brought out with high magnification and shadow casting in Fig. 7, it is not possible at the present time to decide whether these are characteristic for the dried specimens alone or also for the originals. The outstanding characteristic of these details is a transverse structure, particularly at the arrow. In the shadowgram this structure is repeating, with ridges 65 Å wide and intervening valleys 35 Å wide. Perpendicular to these dimensions, the average width of the fibers themselves is 300–400 Å. The width of the ridges is compatible with the length to be expected from the data in Table 1 for the individual V_2O_5 crystals in sols of this age. On this hypothesis, each ridge defines an array of crystalline particles oriented parallel to each other and also, though with considerable less regularity, parallel to the fiber axis. An orientation of the crystal rods perpendicular to the fiber axis, assuming that the rods have a length of 300–400 Å, is less likely but is not to be excluded. The possibility that the fine structure of Fig. 7 may not be representative of the original

structures in the liquid medium imposes even more reservations upon a tempting further comparison between this transverse structure and the fine structure of collagen fibers, shown by electronmicroscope (9).

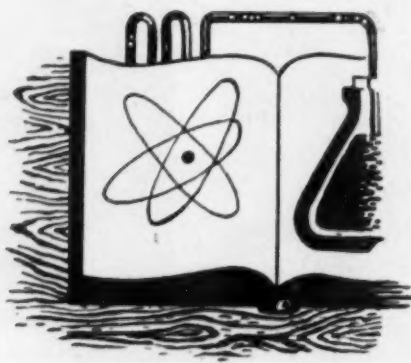
A freshly prepared solution of V_2O_5 is known to exhibit Newtonian flow. On aging, anomalous (elastic) flow is observed. Finally, the tactophase acquires the typical consistency of a gel-phase. These rheological changes, which accompany and are the result of the development and subsequent transformation of the anisotropic structures discussed, add further support to the concept that tactoids (geloids) may be the primary elements responsible for gel formation, at least in those systems where no chemical cross-linking occurs (5).

In conclusion, it is worth pointing out that no effects of electron bombardment upon any of these specimens were noted even under a biased gun at high intensity. This contrasts with the observations published earlier concerning the effects of electron bombardment upon "young" elliptical particles which form the elements of smectic tactoids of WO_3 (12) and also removes any possibility that the structures reported here are pseudostructures introduced by electron bombardment (11).

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TECHNICAL PAPERS

Alleviation of Experimental Diabetes in Man by Administration of Reduced Glutathione (GSH): Metabolic Implications¹

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It has been reported from this laboratory (1, 3) that a state of metabolism similar to that observed in clinical diabetes mellitus can be produced in normal men and women by the administration of suitable amounts of purified preparations of pituitary adrenocorticotrophic hormone (ACTH). The condition produced is characterized by sustained glycosuria and hyperglycemia, glucose tolerance curves characteristic of the diabetic state, and relative resistance to the hypoglycemic effect of exogenous insulin. During administration of ACTH the developing diabetic state is accompanied by a decreasing concentration of blood glutathione (2). Because of a temporally related upheaval of purine metabolism (the precise nature of which remains unknown) which is manifested by a sustained increase of urinary uric acid, we have hypothesized that a purine metabolite, exerting an alloxan-like effect, is responsible for reducing the intracellular availability of free sulfhydryl ($-SH$) groups, which are necessary for normal activity of many enzyme systems; that the combination of decreased intracellular concentrations of $-SH$ and increased intracellular concentrations of purine metabolites impairs functional activity of the insulin-producing cells of the pancreas (the product of which is a protein rich in cystine) and also interferes with peripheral glucose utilization by inhibition of those enzyme systems which require free $-SH$ groups. In addition to hyperglycemia, and contributing to the degree of glycosuria, is the effect of ACTH in decreasing renal tubular reabsorption of glucose. This easily followed phenomenon can be assigned with reasonable justification to inhibition of an enzyme within the tubular epithelium.

An extensive metabolic balance study (30 days) was made upon a normal young man to determine whether

or not large amounts of GSH administered intravenously would reverse (despite continued ACTH administration) an already established hyperglycemia and glycosuria. After an 8-day base-line period, ACTH³ (68 mg/day, Armour Standard) was given in equal doses every 6 hrs for the following 6 days. On the fourth day of ACTH, pure reduced glutathione (buffered to neutrality and put in solution and into sealed glass containers under nitrogen) was given intravenously in the following amounts: 8 gm at 8 a. m., 4 gm at 1 p. m. and 4 gm at 2 p. m. On the sixth day of ACTH, 4 gm more of GSH were given at 2 p. m. The post-ACTH balance study was continued for the next 16 days. In addition to 24-hr balances throughout, blood specimens were obtained hourly from 8 a. m. to 4 p. m. daily, and urine specimens were col-

TABLE 1

Day of ACTH	1	2	3	GSH* (4)	5	6
Fasting blood sugar (mg/100 cc)	71	73	108	124	134	148
Blood sugar—average of 9 a. m., 2 p. m., 3 p. m. (mg/100 cc)	115	165	184	157	204	193†
Urine sugar—8 a. m.—4 p. m. (gms)	1.0	5.1	14.7	4.0	16.2	24.3

* GSH: administered at 8 a. m., 1 p. m., and 2 p. m. on day No. 4.

† Values for this average are 198 at 9 a. m.; 201 at 2 p. m.; and 179 at 3 p. m. GSH administered once on this day at 2 p. m.

lected every 2 hrs from 8 a. m. to 4 p. m. for 11 consecutive days which included the 6-day ACTH period. A large number of determinations other than those relating to carbohydrate metabolism were made upon these samples.

Renal glycosuria occurred on the first day of ACTH. Hyperglycemia became evident on the second day and continued with increasing intensity through the entire ACTH period *except during the intervals when GSH was administered*. The reversal was dramatic but transitory, lasting 1–2 hrs after each injection of GSH. Most striking were (1) sharp elevation of the renal threshold for glucose and (2) a fall of the blood sugar level. These phenomena resulted in glucose-free urine during each hour immediately following administration of GSH. Table 1 summarizes the influence of GSH

³ We are indebted to John R. Mote, The Armour Laboratories, Chicago, Illinois, for the purified ACTH used in these studies.

⁴ Both blood and urine glucose were determined by the Somogyi procedure as modified by Nelson (5).

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² We wish to acknowledge the valuable assistance of Frank H. Bethell, assistant director of the Simpson Memorial Institute, in the performance and interpretation of the hematological studies.

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(during its effective period) upon glycosuria and hyperglycemia produced by ACTH.⁴

The effect of GSH in simultaneously reversing ACTH-induced hyperglycemia and renal glycosuria seems all the more striking since sudden cessation of glycosuria would be expected to result in further increase of hyperglycemia were the rate of utilization of glucose not significantly increased or the supply to the blood significantly decreased. Since a severe degree of negative nitrogen balance remained uninfluenced by GSH, decreased glycogenesis from protein was probably not a factor. That hepatic glycogenolysis may have been inhibited remains as a possibility to explain the fall of blood sugar.

Since GSH inactivates insulin *in vitro*, such an effect *in vivo* should have raised the blood sugar level. If this occurred to any degree, its effect was minor as compared with those forces which produced an actual fall of circulating blood sugar.

Also observed were other metabolic reversals of major significance. Among the most striking was a profound change in the number and character of the circulating white blood cells. This remarkable change, which lasted 1-2 hrs, was opposite in direction to the effects which we have observed repeatedly in normal people receiving ACTH for a number of days (4). These findings are being reported in detail elsewhere.

Not all of the metabolic effects of increased adrenal corticoid activity were reversed by administration of GSH. This indicates that reversal of those metabolic effects which responded to GSH was not by virtue of a block in steroid production. It seems likely that the changes are due to improved performance of those systems which require free sulfhydryl groups for their normal function. This appears to be the case with respect to (1) renal tubular reabsorption of glucose, (2) the systems involved in utilization of glucose, and (3) the systems responsible for production and release of white blood cells.

It is believed that the results reported give added weight to our hypothesis. The forces at work in the early stages of the development of human diabetes may be very similar to those described in this and in our previous studies. Of somewhat broader significance are the implications with respect to abnormalities of metabolism generally. Hormonal control of enzymatic processes, mediated via independent effects of the same hormone upon other systems, appears to be a fertile field for future investigations. But it implies the necessity of establishing techniques which can be applied in the intact animal or man.

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Production of Acute Gouty Arthritis by Adrenocorticotropin¹

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It has long been known that attacks of acute gouty arthritis can be precipitated by exposure to nonspecific stresses such as trauma, infection, operation, chilling, foreign protein therapy, X-radiation, and many other stimuli. These stresses have been shown to produce a syndrome of increased adrenal cortical activity (5) and associated biochemical and histologic changes, commonly referred to as "the alarm reaction" (4).

It is likely that all forms of nonspecific stress call forth increased adrenal cortical activity through a common pathway. This pathway is increased secretion of pituitary adrenocorticotropin (ACTH), which in turn stimulates the adrenal cortex (4).

ACTH has therefore been given to four patients with gout and has precipitated three attacks of acute gouty arthritis in five trials. The entire syndrome of electrolyte and water changes observed to occur with the acute attack of gout (7) has also been reproduced by the administration of ACTH.

In addition, since it was shown that the attack of gout follows a phase of relatively decreased adrenal cortical activity, the administration of ACTH to two patients during an attack of acute gouty arthritis produced a prompt disappearance of the acute arthritis. This aspect of the action of ACTH resembles that of colchicine, which relieves the acute attack of gout and is a potent stimulus to increased adrenal activity (2).

Three of the four patients were studied on a metabolic ward and received diets of known composition. After a control period of four days, 150 mg (equivalent to Armour standard) ACTH³ was given by intramuscular injection each day in divided doses for four days.

Control serum uric acid was elevated in all patients. During the administration of ACTH, there was an increase in urinary uric acid and nitrogen and a decrease in sodium and chloride excretion. Three patients had glycosuria of one to three gm daily. In two patients, there was a significant increase in glomerular filtration rate, renal plasma flow, and uric acid clearance (1). The circulating eosinophils disappeared while ACTH was being given.

For three days following completion of the ACTH injections, there was an excretion of sodium and chloride considerably greater than the control values while the uric acid excretion returned to the control value. The

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³ Supplied by The Armour Laboratories through the kindness of Dr. John R. Mote, Medical Director.

increased electrolyte excretions may be interpreted as a phase of decreased adrenal cortical activity due to withdrawal of the ACTH.

The attacks of acute gouty arthritis began during the third and fourth days of the postinjection period, when the electrolyte and water diuresis was almost completed. Each attack resembled the classic picture of acute monoarticular arthritis. The two patients who did not develop acute arthritis nevertheless exhibited similar changes in urinary excretion during and following the administration of ACTH. This sequence of electrolyte changes in gouty patients has previously been described as "the gout cycle" (6).

In two attacks, one of which had been provoked by ACTH and the other by a mercurial diuretic, 200 mg ACTH given over a 36-hour period starting on the first day of the attack was followed by a disappearance of joint signs within 48 hours after the injections were completed. Untreated attacks of acute arthritis in these patients had previously lasted 10 to 14 days. The increased electrolyte excretion following the mercurial diuretic mimics "the gout cycle" and in this manner may be involved in precipitating the attack of acute arthritis.

The results suggest that stimulation of adrenal cortical function is the common pathway in the precipitation of acute gouty arthritis by nonspecific stress and that pituitary adrenocorticotropin may be useful as a provocative and therapeutic agent in gout.

Since this work was completed, similar results have been reported in one patient (3).

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A Simple Method for Welding Thermocouples

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The use of thermocouples in physiological problems, for such purposes as recording respiration or blood flow, necessitates the use of very small wires which often are very difficult to solder or braze by conventional methods. Furthermore, the sensitivity of the thermocouple is dependent on the type of joint, for a large juncture allows

local currents of considerable magnitude to flow, thus reducing the effective voltage output. The introduction of foreign metals in the soldering or brazing process sets up contact electromotive forces with the same deleterious effects.

These metals may be welded, however, by the method to be presented here. The materials necessary are shown in Fig. 1. It is simply a metal cup containing a few

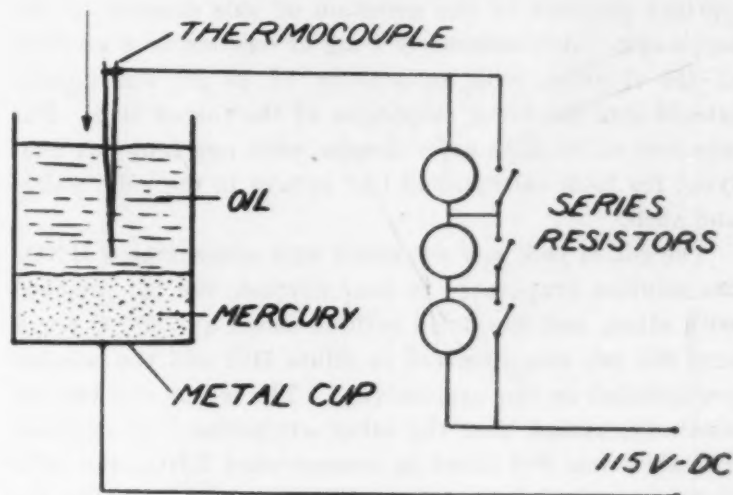


FIG-1

millimeters of mercury under about 2-3 cm of oil. Mineral oil or 10-30W motor oil may be used. In the apparatus now in use in this laboratory, the cup consists of the inverted metal shell of a vacuum tube with a grid cap (6J7). The cup is connected to one side of the d-c main, and the thermocouple wires to the other side through a series resistor as shown. The thermocouple is then moved down to touch the surface of the mercury and withdrawn. Welding is accomplished by heat from the arc formed at the moment of contact with the mercury. A "buzz" accompanied by slight boiling in the oil layer signifies good contact. The size of the series resistor depends on the size of the wires to be welded, as a larger current will be required for larger wires. We use a 400-w heating element for 0.3-mm iron-constantan couples. A little experimentation will quickly show the optimum value of current, as too much current causes burning of the wires with a large junction, and too little current does not weld at all.

The method of preparing the wires for welding is as follows: They are first twisted tightly together for a distance of several millimeters; the distal end of the twisted junction is then cut off so that only a turn or so remains. The wires are now ready to weld, and after welding they may be untwisted if any of the twisted portion remains unfused, so that the wires are joined only by a small ball of fused metal. This ball should be as small as possible, without sacrificing the strength of the joint.

This method has been utilized with iron-constantan, platinum-platinum-rhodium, chromel-alumel, and copper-constantan couples, with wire sizes from 0.1 mm to 4 mm. A larger cup with more and heavier oil is required for the larger wires. The circuit should be fused in all cases.

Secretion of Radioactive Calcium in the Hen's Egg¹

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The availability of pile-produced Ca^{45} has facilitated investigation of the economically and fundamentally important problem of the secretion of this element in the hen's egg. Approximately 1 mg of calcium as a solution of the chloride, with an activity of 15 μc , was administered into the lower esophagus of the fasted bird. For a period of 20 days after dosage, each egg laid was analyzed for total calcium and Ca^{45} uptake in the yolk, white, and shell.

The entire yolk was wet ashed with concentrated HNO_3 , the solution evaporated to near dryness, the fat removed with ether, and the dried residue ashed at 750° C for 8 hrs; the ash was dissolved in dilute HCl and the calcium precipitated as the oxalate (2). The white was treated similarly, except that the ether extraction was omitted. The shell was wet ashed in concentrated HNO_3 , the solution evaporated to near dryness and prepared directly for the oxalate precipitation step. The calcium oxalate was collected on filter paper over a uniform area for measurement of total calcium by weight and of radioactivity with a thin mica-window Geiger counter (1). Self-absorption and decay corrections were made in the usual manner.

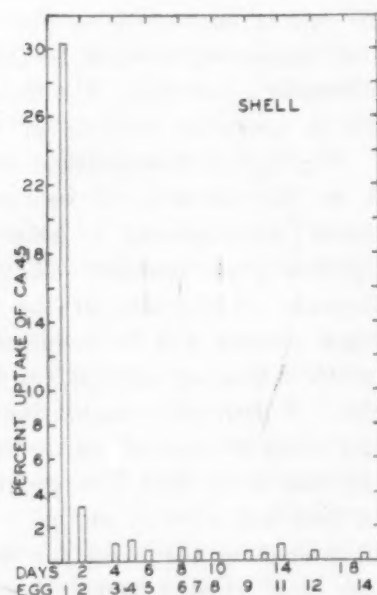


FIG. 1. Percentage of Ca^{45} , fed as a single dose, appearing in shell of successive eggs.

Single dosage studies were made with two birds and a multiple feeding trial with another; the results were in fair enough agreement, so that for clarity data from only one bird are presented. Fig. 1 shows the percentage uptake of administered Ca^{45} in the shells of the successive

¹ Published with the permission of the director of the Florida Agricultural Experiment Station. The Ca^{45} was obtained from the Oak Ridge National Laboratory on allocation from the Atomic Energy Commission.

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eggs. In an egg laid 15 min after dosage, the shell contained a detectable amount of the labeled calcium representing 0.07% of the dose. It was observed that the shell of the 24-hr egg contained 30–35% of the dosage, the values thereafter falling sharply and leveling off at about 0.5%. It is considered from the time factor and the constancy of the values that the labeled calcium found in the shells after the fourth day reached there via the body stores.

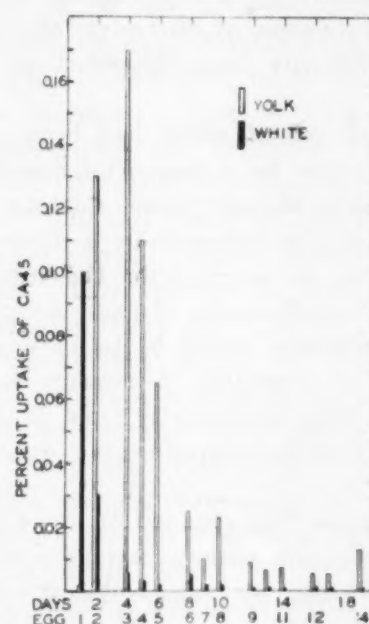


FIG. 2. Percentage of Ca^{45} , fed as a single dose, appearing in yolk and white of successive eggs.

Fig. 2 shows the percentage uptake of administered Ca^{45} in the yolk and white of successive eggs. No labeled calcium was detected in the yolk and white of an egg laid 15 min after dosage. In the 24-hr egg it was noted that the white contained about 70 times as much Ca^{45} as did the yolk, which probably reflects the prior maturity of the latter. The situation was reversed in the egg laid at 48 hrs, and thereafter the yolk always showed a somewhat greater accumulation of labeled calcium than did the white. The total percentage accumulations in the yolks, whites, and shells of the 14 eggs collected after dosage were 0.7, 0.2, and 40, respectively. This emphasizes the ability of the hen to incorporate a large percentage of the ingested soluble calcium into the shell of the egg. It was calculated from the total dietary calcium intake and output in the eggs and the reported data that a maximum of from 60 to 75% of the calcium in the egg reached there directly from the ingested calcium, the remainder probably being drawn from the body stores. Bone analysis at the termination of the experiment indicated that considerable skeletal storage had occurred; the left pubis contained about 1 μg of labeled calcium/gm of bone. About 0.005% of the dose was found in the blood at termination.

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Statistical Data on Glacial Boulders¹

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While doing field work in the James River area in eastern South Dakota and in the Crosby-Minot area in northwestern North Dakota, both of which areas are covered by glacial drift, the writer recorded the distribution of boulders as a help in mapping small moraines that might have a significant relation to the occurrence of shallow ground-water supplies.

There are, of course, many more small boulders than large ones. The total number in each area examined was too great to be easily recorded, but all boulders noted that were 4' long or longer were measured. On grouping the measurements into half-foot sizes it was found, as could be expected, that the number in each group increased rapidly with the decrease in size. For boulders between about 4' and 9' in length the rate of change seemed to follow nearly a mathematical sequence. The number of boulders more than 9' in length was too small to form groups showing such a regular change. J. B. Mertie, Jr., considers that, within the size limits measured, the data suggest some logarithmic law of distribution (written communication). When plotted on semilogarithmic paper the numbers lay nearly along a straight line, as shown in Fig. 1. The rate of increase seems to be nearly the same in each of the two areas examined, as the plotted lines are nearly parallel. Partial calculations have indicated that size-groups based on the product of the three principal dimensions of the boulders would give a similar mathematical series; perhaps because the great majority of the boulders are of approximately the same shape, being roughly oval in both transverse and longitudinal cross sections.

The average number of boulders 4' long or longer to the square mile is nearly twice as great in the James River area as in the Crosby-Minot area. In the James River area, however, boulders less than 4' long are not very plentiful, and piles of cobbles are uncommon; whereas in the Crosby-Minot area small boulders and great piles of cobbles in the fields and road corners are very common. An attempt to extrapolate from the observed data, in order to estimate the number of boulders 2'-4' in length that might be available for riprap on irrigation works, seemed to be of doubtful value because of the scarcity of small boulders in the James River area and the rapid increase in their number with decrease in size in the Crosby-Minot area. In the latter area, the tendency for the number to increase more rapidly with smaller size may be indicated by the 825 boulders 4.0' to 4.4' long that were noted, as this number is greater than it should be to accord with the number in the larger size groups.

R. F. Flint has found that in glaciated areas the proportion of large boulders increases as the age of the drift decreases and that this seems to hold true from the

Nebraskan through the late Wisconsin drift. He has also found that deeply weathered boulders are usually associated with the earlier ages of drift (written communication). The distribution of boulders in parts of Ohio was recorded by R. P. Goldthwait as a help in tracing minor moraines (oral communication).

Studies of glacial drift, based on the percentages of pebbles of different sizes in the gravels, have been made;

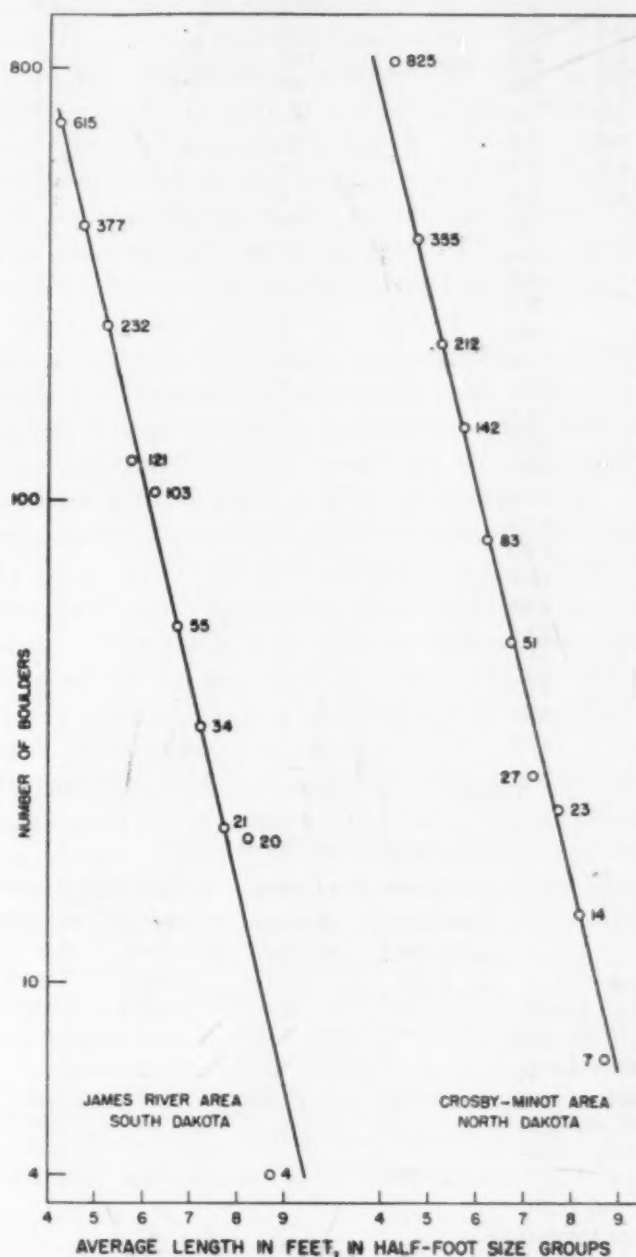


FIG. 1. Number of glacial boulders of different size-groups in areas in South Dakota and North Dakota.

but the writer has not learned of any statistical studies that may have been made on the number of boulders of different size-groups in areas of glacial drift. However, studies of similar logarithmic sequence in the sizes of crushed materials have been made by Austin (1), who mentions that the mathematical data may be applicable to the determination of concrete aggregates; by Roller (3); and by Epstein (2), who has applied them to the sizing of coke. The mathematical sequences present in many natural phenomena have been commented on by Sawyer (4), who states: "It is indeed remarkable how much of the physical world, amid the conflicting action

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of a great variety of unconnected forces, can be described by the simplest mathematical function, x^a and ex^b ."

TABLE 1
Sizes of glacial boulders

Boulder length (feet)	James River area*	Crosby-Minot area†
4.0 to 4.4	615	825
4.5 " 4.9	377	355
5.0 " 5.4	232	212
5.5 " 5.9	121	142
6.0 " 6.4	103	83
6.5 " 6.9	55	51
7.0 " 7.4	34	27
7.5 " 7.9	21	23
8.0 " 8.4	20	14
8.5 " 8.9	4	7
9.0	8	
9.1		4
9.2		1
9.3		1
9.5	6	5
9.6	1	
10.0	7	1
10.2	1	
10.5	2	3
10.7	1	
10.8		1
11.0	1	
11.2		3
11.3		1
11.6		1
12.0	1	
13.0	2	1
13.5	1	1
15.0	1	
17.0	1	1
Totals	1,615	1,763

Rock types of glacial boulders

	James River area		Crosby-Minot area	
	Number of boulders	Percent of total	Number of boulders	Percent of total
Granite	1,481	91.7	1,084	61.5
Granitic gneiss	54	3.3	476	27.0
Very hard horn- blende-biotite gneiss	40	2.5	43	2.4
Garnet schist			14	0.8
Paleozoic lime- stone	30	1.8	99	5.6
Very hard sili- ceous sandstone			32	1.8
Basic igneous rock	1	0.7	8	0.9
Greenstone	7			
Tertiary sand- stone (Fort Union form)	2		7	
Totals	1,615	100.0	1,763	100.0

* James River area, 1,170 square miles examined; average, 1 boulder to 0.73 square mile.

† Crosby-Minot area, 2,600 square miles examined; average, 1 boulder to 1.47 square miles.

More than 90% of the large boulders in each area are of granite, gneiss, and schist, and nearly all are of hard, unweathered rock. No large weathered boulders were seen in the Crosby-Minot area, but 10 large boulders of deeply weathered granite were recorded in the James

River area. Table 1 shows the number of boulders of each size-group and the kinds of rock in each area.

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Characteristics of the Desoxycholate-treated Cytochrome Oxidase¹

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In 1947 the authors reported the preparation and partial purification of a solubilized cytochrome oxidase (9). This article is concerned with its further characteristics and the methods employed in an attempt to purify the desoxycholate-treated cytochrome oxidase.

Physical appearance: The insoluble cytochrome oxidase complex (1, 5) is tan, opaque, and particulate in appearance. A partially purified preparation (2-3%), made as previously described (10), is clear to the naked eye and light yellow in color.

Lyophilization: All of the desoxycholate-treated oxidase preparations reported in this and in previous papers may be lyophilized from the frozen state and stored at 0° without loss of activity.

Variations in Q_{O_2} protein: The partially purified preparations from lamb heart vary in their activity by as much as 35%, having Q_{O_2} protein values ranging from 1,500 to above 2,000 when tested with the hydroquinone system previously described (10). These variations may be ascribed in part, at least, to the amount of protein in the insoluble cytochrome oxidase suspension which seems to be directly related to the amount of sodium desoxycholate that must be used for the first extraction.

Gel formation: The preparation of the partially purified enzyme is often made difficult by the formation of a gel. This gelation seems to be a property of the desoxycholate when dissolved in phosphate buffer (7, 8). The oxidase activity is not impaired, however. If the final supernatant is left to stand at 0°, it will invariably gel. This gel may be liquefied by simply warming the tube in the hand.

Denaturation on standing: A partially purified preparation (1.5-3%) has been kept at 0° in both the con-

¹ Aided by a grant from the John and Mary R. Markle Foundation.

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concentrated form (gelled) and diluted form for 6 days without loss of activity. When tested on the tenth day, after bacterial contamination was marked, the concentrated preparation showed no loss in activity and the dilute preparation a 30% loss.

In view of the loss in activity of the insoluble cytochrome oxidase complex when tested in a system involving the oxidation of D-glucose by added D-glucose dehydrogenase protein, diphosphopyridine nucleotide, and cytochrome C (3), it is particularly interesting to note that the insoluble oxidase preparations discussed above showed no significant loss in activity in 13 days when tested with the hydroquinone system. These observations suggest that a factor is destroyed in the aging of the insoluble cytochrome oxidase complex which is necessary for the oxidation of D-glucose by the previously mentioned system, but which is not required for the oxidation of hydroquinone.

TABLE 1

Temperature (°C)	Q _{o2} protein	Loss in activity (%)
Unheated	2180	...
40	1150	53
45	710	67
50	460	79
55	150	93
60	0	100

Heat stability: Table 1 shows the destruction of enzymatic activity at a relatively low temperature. There was no visible precipitate in any of the tubes after the partially purified and diluted (1:25) preparation (2-3%) had been heated for 5 min at the temperatures noted. The tests were made as previously indicated (10), except that semicarbazide (0.3 ml of a 0.1 M solution) was used as a ketone fixative.

In another experiment, neither the insoluble nor the partially purified preparation suffered any loss in activity after being heated for ½ hour at 37°.

pH optimum: Preliminary experiments indicate that the oxidation of reduced cytochrome C by a partially purified, lyophilized preparation (2-3%) occurs most rapidly at pH 7. The 0.05 M buffers used and their pH values are as follows: acetate, pH 5.04; phosphate, pH 7.0; phosphate, pH 7.95; borate, pH 8.8; glycine, pH 11.05.

The methods used in an attempt to purify the oxidase are as follows:

Dialysis: Dialysis for 18 or 24 hrs does not significantly alter the activity. However, in an experiment where a 1.5-3% preparation was used in both the concentrated and the dilute (1:25) form, there was a considerable precipitate at the end of 3 days of dialysis (the water being changed each day) and the preparation was inactive. A crude test showed little or no desoxycholate to be present. Added desoxycholate dissolved the precipitate but did not restore the activity.

Other experiments indicate that it may be possible to remove the desoxycholate without too great a loss in activity by dialyzing against 0.01 M KH₂PO₄-Na₂HPO₄ buffer of pH 7.4 or above. This is being further investigated.

Centrifugation: In 1944, Haas (4) reported the separation of his cytochrome oxidase preparation into 2 components by centrifugation at 10,000 rpm for 2 hrs. This separation has been reviewed by Keilin and Hartree (6). Our experiments demonstrate that even the dilute preparations (1:25) can be centrifuged at 20,000 × g for 2 hrs without any indication of a separation of components.

Effect of pH: The pH of our partially purified preparation (1.5-2%) is approximately 8. By gradually lowering the pH of a diluted sample with HCl, we find that at pH 6.2 the activity is still in the supernatant (slight precipitate removed), while at pH 5.78 the partially inactivated enzymes are in the precipitate together with the desoxycholate.

Use of alcohol: A 0-4% preparation can be partially purified by fractional precipitation with ethyl alcohol. Preliminary experiments on a lyophilized, partially purified preparation (1.5-2%) show that no visible precipitate forms with as much as 80% of alcohol at 0°. This concentration of alcohol completely destroys the oxidase.

Effect of ether: It was assumed, as previously suggested (10), that the oxidase complex might be a lipoprotein. An attempt was made to separate the lipoidal component by the use of ethyl ether. The activity of a partially purified oxidase (1.5-2%) was completely destroyed by washing with ether.

Preferential solubility in sodium desoxycholate: It has been shown (10) that the addition of a small amount of desoxycholate (1.5 or 2%) to the insoluble preparation dissolves proteins of low activity, whereas larger amounts of desoxycholate (3 or 4%) dissolve active proteins as well. It was on this observed differential solubility of the active and inactive proteins that the partial purification was based. It seemed possible also that the various components of the oxidase complex could be separated by successive additions of small amounts of desoxycholate. Favorable results have been obtained by the use of this method, and a preliminary report has been presented (2).

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The Analgesic Action of Teropterin¹

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In 1947 Farber and his associates (1) indicated that teropterin, when administered to patients suffering from various forms of cancer, made it possible in some instances to reduce the amount of analgesia required. This indicated that teropterin possessed a certain amount of pain-relieving activity. Lehy, *et al* (2) stated categorically that "Our clinical observations indicate that the drug is nontoxic in the dosage given. Pain was relieved in most instances, if not all, by the use of teropterin. This obviated, in the main, the necessity for further use for opiates with their concomitant depressive effect."

These clinical observations on the analgesic property of teropterin were of interest in our laboratory, and we decided to prove or disprove the pure pain-relieving activity of this drug.

Twelve experiments on premedical students were performed, using a modified Wolff-Hardy-Goodell technique. Each one of the subjects received a 20-mg dose of teropterin injected intramuscularly. Neither the operator of the pain threshold apparatus nor the subject was cognizant of the nature of the drug that was injected, since all doses were administered by a third individual.

A definite rise in the pain threshold response was observed 15 min following the injection of 20 mg of teropterin. On an average, the peak of the effects were reached in 70 min and lasted for 155 min. Teropterin produced a 6.6% rise in pain threshold when the peak of the effects were reached. In each instance the experimental data showed that the effects were always in the same direction. This fact made it clear to us that teropterin was actually producing a true analgesic effect.

The results on 12 subjects definitely indicate that teropterin causes analgesia as interpreted by a rise in pain threshold in man. This confirms the clinical observations thus far reported. Contrary to the sense of well-being and some slight euphoria as was noted in those patients with cancer who received teropterin, we did not observe any of these effects. Nausea and other subjective symptoms were also lacking.

Teropterin possesses true analgesic action when tested on the normal human subject. This activity should be of value in reducing the amount of sedation needed when teropterin is used clinically.

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¹ Teropterin was kindly furnished by the Lederle Company, Pearl River, New York.

Flow in a Thin Glass Capillary as Affected by Wetting the Exterior of the Capillary¹

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A review of pertinent literature has revealed widespread evidence that the outermost monolayer of molecules at the phase boundary of a liquid induces an orientation extending into the body of the liquid for many molecular lengths (1). The most reliable examples involve a range of orientation from a few tens of Angstrom units to a few thousand. The experiments of Nutting (3), however, pointed to an immobile layer of much greater depth.

Nutting found that the flow of crude petroleum oil through a narrow thin-walled glass capillary was appreciably slowed (6.8%) when the *outside* of the capillary was surrounded with water. He accounted for this by postulating an immobile layer of oil on the inside of the tube no less than 65,000 Å thick. Kaminski, working in these laboratories and following the method outlined by Nutting, obtained comparable results (2).

It was apparent, however, that the effect could have been due to variations in temperature, since the temperature coefficient of viscosity of the medicinal paraffin oil used by Kaminski was such that the flow would have

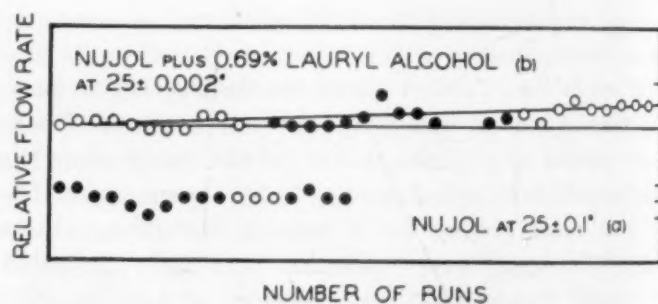


FIG. 1. Relative flow rate plotted against the number of passes through the capillary in (a) Series 1, and (b) Series 3. Open circles refer to passes when the outside of the capillary was dry; solid circles when the capillary was surrounded by water.

increased 7%/°C. Nutting's effect could be accounted for by the oil's being a degree warmer when not surrounded by water, and Kaminski's could be accounted for similarly by variations of a degree or two. This might well have occurred if the apparatus or the oil had been exposed to radiant energy during a measurement, or if the room temperature had risen just before a measurement. The particularly marked retardation in the flow of crude petroleum reported by Nutting and confirmed by Kaminski might thus be explained by the strong absorption this oil shows in the near infrared. Either of these variations would have warmed the dry capillary or reservoir of oil more rapidly than the capillary surrounded by a relatively large mass of water, and would then have led to a faster flow in the dry tube than in the wet.

¹ This work was done under contract between the Office of Naval Research and Stanford Research Institute.

Series 1: In order to evaluate the effect of temperature variations, Kaminski's apparatus was transferred to an air thermostat whose temperature varied less than 0.1° . It seems most unlikely that moving the apparatus into the thermostat could have changed any condition other than temperature, which may have been responsible for the Nutting effect observed by Kaminski. Deviations in flow rate up to 1.5% from the mean value were observed, but they showed no discernible consistent change after the capillary had been immersed in distilled water overnight, or after it had been allowed to dry out again for 3 days. The data are plotted in Fig. 1a.

Series 2: A more precise control of temperature was obtained by immersing the jacket containing a capillary in a water thermostat at $25^\circ \pm 0.002^\circ$. The internal diameter of this capillary was 0.747 mm. In these experiments, the capillary was made part of a U-tube, enlarged at one point to form a small reservoir, in the manner of an Ostwald viscosimeter. Great care was taken to eliminate possible surface active impurities. The entire apparatus was flamed to incipient fusion while a current of dried filtered air was passed through it. Both entrance tubes were bent downwards and guarded by plugs of glass fiber. The Nujol had stood with 10 per cent of its weight of Florisil (an activated silica) for a week with occasional shaking, and was centrifuged before use.

Thirteen runs were made in the dry capillary, 9 after filling the jacket with water, followed by 5 more after drying again. The flow times varied within 0.4% of the mean value (between 360 and 363 sec) with no indication of a consistent increase during the period of wetting. The experimental errors were magnified somewhat by an uncertain drainage of the measuring reservoir, which was below the capillary in this apparatus.

Series 3: Since a small percentage of a polar long-chain compound might produce an oriented immobile layer under conditions where a nonpolar oil would not, lauryl alcohol was added to make a 0.69% solution. (The Nujol wetted the glass, the lauryl alcohol solution did not.) The flow times relative to the first value, plotted against the number of runs, are shown in the upper plot (Fig. 1b). The radius of the circle represents probable errors in the timing, but does not take into account the variable drainage of the tube. It will be seen that any retardation that may have occurred on wetting the outside of the capillary is less than the random fluctuations (about 0.5%). A small but definite retardation with time of about 0.5% may be seen, however. The film thickness necessary to account for this would be about 0.9μ , instead of 6.5μ , which although still high, is more nearly in accord with the observations of others in this general field. It may also be due at least in part to slight clogging of the capillary by traces of suspended matter.

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Paper Chromatography of Flavonoid Pigments¹

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Although the use of classical chromatographic adsorption methods for the separation of flavonoid pigments from plant extracts has been reported previously (3, 4, 5), such methods have not been successful in the separation of microquantities of these compounds. In a search for better methods of examining plant extracts for flavonoid pigments, we have applied the method of paper partition chromatography (2) to the problem. This pre-

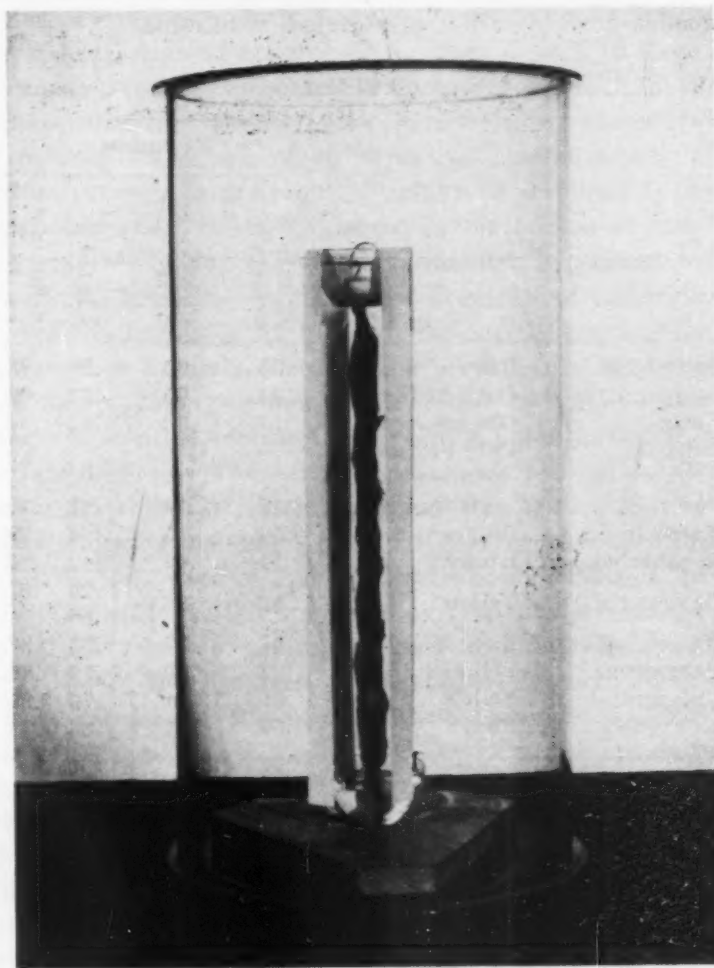


FIG. 1.

liminary report deals with the determination of R_f values for 11 flavonoid pigments in chloroform, ethyl acetate, phenol, and n-butanol-acetic acid; the separation of mixtures containing four to six of these pigments; and the use of color developing sprays to locate and identify the pigment zones.

¹This investigation was supported by a research grant from the Division of Research Grants and Fellowships of the National Institutes of Health, U. S. Public Health Service. The samples of isoquercitrin, robinin, and kaempferol were kindly donated by the Pharmacology Laboratory, Bureau of Agricultural and Industrial Chemistry, Albany, California; the sample of naringin was donated by the California Fruit Growers Exchange, Research Department, Ontario, California. The other pigments were purchased from the S. B. Penick Company, New York City.

Several forms of one-dimensional apparatus have been tried during the course of this study. The one which served best (Fig. 1) was a modification of an apparatus recently described by Winsten (6). Discarded gasoline pump cylinders, 12" in diameter by 26" in height and closed at each end by a ground glass plate, served as vapor chambers. For troughs, 3" Pyrex evaporating dishes have been used in place of the Petri dishes recommended by Winsten. From four to six strips can be accommodated at one time in the upper dish. A small glass stopper was used to hold the end of the strip in the solvent, and the weight of the wet strip prevented its touching the walls of the trough. This eliminated the danger of capillary siphoning without recourse to any special supports to hold the paper away from the inner and outer walls of the trough. The lower dish was fastened to a wooden base by means of stainless steel clips.

TABLE 1

Pigment	Fluorescence	R _f values			
		Ethyl acetate	Chloroform	Phenol	n-Butanol acetic acid
Quercitrin	Brown	.36	.05	.50	.83
Isoquercitrin	Dark brown	.64	.05	.53	.62
Rutin	Orange-brown	.17	.08	.42	.34
Robinin	Pale brown (turns to yellow-orange)	.17	.14	.23	.78
Naringin	Blue-white	.53	.15	.84	.59
Xanthorhamnin	Brown	.11	.06	.42	.25
Rhamnetin	Yellow	.96	.96	.25 .68	.87
Homoeriodictyol	None	.97	.87	.95	.97
Quercetin	Yellow	.93	.05	.32	.80
Kaempferol	Yellow	.96	.12 to .17	.70	.95
D-Catechin	None	.87	.11	.36	.78

Chromatograms of the individual pigments were prepared, using phenol, chloroform, ethyl acetate, and n-butanol-acetic acid. The first three of these solvents were saturated with water before use, and water, saturated with the appropriate solvent, was used in the lower trough. The three-component system n-butanol-acetic acid-water (40-10-50 vol.%) was used as the fourth solvent in a similar manner.

Whatman No. 1 filter paper, 47×57 cm, was cut into strips, 2.5 cm×56 cm, by means of a power-driven paper cutter. The strips were spotted 8 cm from one end with 12-18 μ l containing 7-10 μ g of flavonoid pigment, and then allowed to air-dry prior to development of the chromatogram. Development was allowed to proceed until the solvent had traveled 30-40 cm. This required 8-22 hours, depending upon the rate of movement of the individual solvent. The strips were then air-dried and the pigment zones located by their fluorescence in ultraviolet light. The solvent front could also be located by this method, due to the fluorescence of impurities in the paper which traveled with the solvent front.

In the case of homoeriodictyol and D-catechin, neither of which fluoresces in ultraviolet light, it was necessary to spray the strip with a chromogenic reagent in order to locate the pigment zones. D-Catechin was located by spraying the strip with ammoniacal silver nitrate solution. The treated strip was then washed with distilled water and allowed to dry. Homoeriodictyol was located by spraying the strip with alcoholic ferric chloride solution (1%). With ferric chloride solution, homoeriodictyol forms a red-brown spot which is visible on the strip in concentrations as low as 10 μ g.

The ratio of distance traveled by the pigment to distance traveled by the solvent (R_f value) is given in Table 1. The fluorescence of each pigment on the filter strip has also been included. The fluorescence of robinin changed from a pale brown to a yellow-orange color during the development of the chromatogram. This

TABLE 2

Pigment	Na ₂ CO ₃		Alcoholic AlCl ₃		Boric acid-Citric acid		n-Lead acetate		Basic lead acetate	
	a*	b*	a	b	a	b	a	b	"a"	"b"
Quercitrin	YB	YB	Y	Y	Y	Y	YB	OY	Y	0
Rutin	Y	OY	Y	OY	Y	Y	Y	OB	Y	0
Robinin	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Naringin	..	..	..	..	..	..	..	BIW	..	GY
Xanthorhamnin	Y	Y	Y	Y	Y	Y	YB	OY	Y	0
Rhamnetin	Y	Y	Y	GY	Y	Y	B	Y	B	0
Homoeriodictyol	..	..	..	..	..	..	..	..	..	..
Quercetin	YB	OB	Y	GY	Y	Y	B	OB	B	0
Kaempferol	Y	Y	Y	GY	Y	Y	Y	GY	Y	Y
D-Catechin	RB	B	..	..	..	..	B	Blk	Y	..
Isoquercitrin	Y	YB	Y	Y	Y	Y	YB	OY	Y	0

* Column a—color in ordinary light; column b—fluorescence in ultraviolet light; Y—yellow; B—brown; O—orange; G—green; W—white; Bl—blue; Blk—black; R—red; ..—none.

may have been due to a trace of impurity initially present and removed as development proceeded. Rhamnetin gives two zones when chromatographed with phenol.

Mixtures of four to six pigments have been separated on a one-dimensional chromatogram strip by selecting the solvent giving the greatest differences in R_f values for the particular pigments. The R_f value is lowered slightly by the presence of other flavonoid pigments but the relative values appear constant.

The color of the pigment zones in ultraviolet light is an aid in identifying the respective pigments on the developed chromatogram. In addition, many of the usual qualitative color tests for flavones, flavonols, flavonones, and chalcones can be applied to the pigment zones on the strip. This is of advantage in determining whether a particular spot from a plant extract is of flavonoid character and, in addition, is also of value in the tentative identification of a particular flavonoid pigment. Such reagents include: sodium carbonate, ammonium hydroxide, alcoholic ferric chloride, alcoholic potassium hydroxide, alcoholic aluminum chloride, normal lead acetate, basic

lead acetate, ammoniacal silver nitrate, antimony pentachloride in carbon tetrachloride, and boric acid-citric acid in acetone. The reaction products obtained by use of basic lead acetate, normal lead acetate, alcoholic aluminum chloride, sodium carbonate, and the boric acid-citric acid reagent give an intense fluorescence in ultraviolet light and the characteristic color test in ordinary light. This property has been used to locate and identify pigment zones on the developed chromatogram strips. Table 2 lists the visible and fluorescent colors obtained with the latter reagents.

By paper partition chromatography, coupled with the use of chromogenic sprays, one can quickly and easily obtain information as to the presence of one or more flavonoid pigments in a small quantity of plant extract and even tentatively identify the individual flavones, provided the R_f values have been previously determined for a pure sample of the pigment in question. The method makes it possible to separate mixed crystals of two or more flavonoids and to identify microquantities of an isolated pigment by running mixtures of the unknown pigment with samples of known composition on the same strip.

While the present study was in progress, E. C. Bate-Smith (1) reported the successful separation of anthocyanin pigments by paper partition chromatography and suggested the possibility of separating flavonoid pigments from plant extracts by similar methods. Further work with plant extracts is now in progress in this laboratory and will be the subject of a more detailed report in the near future.

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The Inhibitory Role of "Motor" Nerves

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It is well known that immersion of a nerve-muscle preparation in Ringer's solution, deficient in calcium, results in spontaneous activity which is evident in both the nerve and the muscle. The critical concentration of calcium for frogs' sciatic-biceps femoris preparations is approximately 1 millimolar, at which concentration the nerve commences to "fire" spontaneously. When the Ca^{++} concentration is further lowered, the muscle will show spontaneous fibrillation which persists after failure of indirect excitation.

We have shown that the failure of indirect excitation of such preparations is caused by a partial (or possibly complete) depolarization of nerve, as evidenced by a

decrease in motor-axon resting potential. Restoration of calcium promptly restores the resting potential of the axon and indirect excitability of the muscle, at the same time arresting muscle fibrillation. When a comparison is made of the effects of degeneration of motor nerve following section with those produced by gradual withdrawal of calcium ions from the intact nerve-muscle preparation, the course of events is strikingly parallel. Shortly after nerve section the response of the muscle to indirect stimulation through the distal portion of the nerve is somewhat enhanced, as is the response of the muscle to intra-arterial injections of acetylcholine.

Both of these phenomena are observed in the nerve-muscle preparation when the calcium ion concentration is slightly lowered. As the distal portion of the cut nerve degenerates, indirect excitability of the muscle is lost, and the muscle shows greatly increased sensitivity to intra-arterial injection of acetylcholine. Again, both of these phenomena can be demonstrated in the nerve-muscle preparation when the calcium is lowered to the point where loss of polarization of the nerve is reached, accompanied by failure of indirect excitability. Many of the local anesthetics have been shown to prevent depolarization of axon membranes (1, 2); therefore it was not surprising to find that a 1-millimolar solution of procainehydrochloride arrests fibrillation in an intact nerve-muscle preparation immersed in a calcium-free Ringer's solution. We have also shown that procaine, when added to calcium-free Ringer's solution, restores the resting potential of the immersed nerve. The cessation of muscle fibrillation accompanies this restoration and is not due to an effect of the procaine on the muscle itself because the intra-arterial injection of procaine (in concentrations sufficient to block indirect excitability in a normal muscle) into a denervated fibrillating muscle, failed to disturb its activity. It was also demonstrated that the intra-arterial injection of calcium-free solutions into denervated fibrillating muscles did not modify their activity. These findings indicate the validity of the hypothesis previously advanced by one of us concerning the inhibitory action of the normal polarized resting nerve upon muscle (3) and lend support to the belief that the polarized state of the terminal membrane of the normal motor axon, at rest, is inhibitory to the muscle.

Depolarization of the axon membrane or loss of the membrane following section and degeneration of the nerve results in spontaneous muscle activity. Thus passage of a "motor" impulse over a nerve does not, strictly speaking, stimulate a muscle to contract, but, as a result of the removal of the inhibiting effect exerted by the polarized end plate of the motor nerve axon, the muscle "automatically" contracts. Full details of these experiments will be published shortly.

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Comments and Communications

Cultural and Scientific Conference for World Peace

A few days ago an attractive folder arrived in my mail, outlining, complete with olive branch, a "Call to the Scientific and Cultural Conference for World Peace," scheduled for March 25, 26 and 27 in New York City. The call was made by Harlow Shapley, chairman, and the names of a few prominent scientists appeared among the long list of sponsors.

The "Call" decries our cold war policy, the threats to our intellectual cultural and scientific progress, the curtailment of academic freedom and censorship "on our writers, on the motion picture industry, the theatre and the radio," our enormous military expenditures, and the possibility of World War III, and states that we must "reestablish American-Soviet understanding and cooperation, which alone can make peace possible."

Now certainly no thinking American is in favor of armament and war and all the undesirable economic and political sacrifice that another war would entail. But it is also clear that the only logical and scientific way to solve the problem of establishing and maintaining world peace is to consider not the undesirable symptoms of discord but the underlying cause. We must make every effort at our disposal to prevent the catastrophe of another war and this must be based on some means of getting along with Russia. However, it seems quite clear that peace cannot exist between men or between nations without law and order and that our concept of law and order cannot exist without the authority of a government based on the will of the people.

On the basis of these concepts it seems quite clear that, in view of the present state of international anarchy, our only alternative to defending ourselves by force against a potential enemy with the avowed and acknowledged intent of adopting any measure to overthrow our government and our way of life is to throw every resource into an attempt to establish a federal world government powerful enough to prevent war and protect freedom and justice. In this way we would have a reasonable chance of settling our basic differences with Russia politically and legally, rather than by military action.

It therefore seems to me that to consider the type of recommendations proposed for consideration by the "cultural and scientific conference for world peace" without at the same time proposing a sound policy which can assure a mechanism for dealing with Russian-American differences, or those of any other nation, without recourse to war and with preservation of individual freedom and justice under some form of federal world government is definitely inimical to the best interests of citizens of the United States.

As American scientists, we might reasonably ask our colleagues who have taken an interest in this forthcoming conference either to fight within it for adoption of sound, specific proposals for action which might promote world peace (other than unilateral disarmament and appeasement of the present ruthless Russian dictatorship) or to expose the underlying motives of the conference in their true light.

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Terminology for Sedimentation Force in Centrifugation

Adequate terminology for expressing sedimentation force in centrifugation is used by many authors. However, some authors frequently use, for various purposes, the expression of revolutions per minute (r.p.m.) without further qualification to indicate sedimentation force in centrifugation. This manner of expressing the sedimentation condition is almost meaningless to the reader unless either the length of the axis of the centrifuge containers is also given or the type of centrifuge is stated so that the axis may be ascertained and the force computed. The reader deserves an adequate expression of the used force, such as force times gravity or sedimentation constant. If such is not provided, the reader at least is entitled to the information necessary for computing the force times gravity when r.p.m. is used. Since several types of centrifuges and ultracentrifuges with varied length of axis are in use, it is important that more attention be given to adequate terminology.

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Scientific Method and Social Problems

In a discussion of "Science and Security" (*Science*, June 25, 1948, p. 659) E. U. Condon states that "there is still a great reluctance . . . to accept and extend" the use of the scientific method "in the fields of sociology, economics, and politics," and he hopes for "the full acceptance and use of the scientific method in the social sciences."

In this there is the implication that the methods of these sciences are not scientific now—a view that has appeared repeatedly in notes and comments on the needs of social research, and one that is not particularly helpful to those needs. R. O. Bender, in a recent communication (*Science*, December 10, 1948, p. 665), points out some of the discouraging aspects, although he apparently does not altogether accept as final the assumed definition of scientific method. The definition on which such comments are based, as shown in Dr. Condon's discussion, is an equating of science with controlled experimentation. This

description of science and scientific method is certainly inadequate. Astronomy has done very well without subjecting the behavior of stars and planets to experimental controls. Geology has not used this method to any notable extent. Most of Darwin's contribution to biology did not come from such an experimental basis, either in its conception or verification. A problem need not be inaccessible to science if controlled experiments are impossible.

It may be true, as Dr. Bender says, that "social science studies conducted to date, with minor exceptions, have been observational and statistical rather than experimental" and that "understandings so achieved are only approximations, and in many cases inaccurate approximations at that, due to inherent limitations of the methods employed." But of course all the understandings achieved by the physical and natural sciences are also only approximations, and of varying accuracy. Fortunately are those scientific disciplines that can, for most of their problems, use the method of controlled experiment to test and improve the accuracy of their hypotheses. The history of these sciences, however, does not suggest that this is the only scientific method of verification, or that the social sciences must choose the method of control (which is so greatly limited in a democratic society) or be denied the status of sciences.

It would be more useful if the physical and natural scientists, instead of preaching a particular procedural definition of scientific method and commending this to their social science colleagues, would recognize that the division of science into the accepted disciplines is merely a convenience arising from the varieties of methods and interests most useful in investigating different aspects of experience and expectation. Science is not any particular method or set of techniques. It is a way of reasoning. The standards are intellectual rather than procedural. The method of observation, formalization, and testing must vary with the nature of the problem.

There is no unique kind of difficulty facing the social sciences that is not met, at least to some degree, in the natural sciences. All sciences must, in some phase and field, and to some extent, try to cope with such restrictive troubles as a high degree of indeterminacy, a highly heterogeneous universe for sampling, the impossibility of controlling variables, the difficulty of translating a factor or concept into an operationally definable identification or measurement, the need for including the inaccessible past history of a datum in an observation, the effect of observer on observed, and a host of other puzzles which challenge the scientific ingenuity and skill of the investigator. Most of these loom much larger in the social sciences, which have in general a more difficult task than the natural sciences. The need for studying and developing the nonexperimental approaches of scientific method is great, since the applicability of controlled experimentation is so limited.

The field of social science, being in effect the problem of how and why mankind behaves, embraces many sciences. The present state of relative isolation of the

social sciences from the other sciences (and, indeed, from each other) should not be continued. Social science must draw, in part, on the methods and content of other scientific disciplines; philosophy, the humanities, and religion can also contribute. In turn, social science contributes to the development of scientific method and knowledge for all of science.

There is general agreement that our greatest need is an improvement in behavior and in the prediction and control of behavior and that while our accomplishments in material technology are promising, they are also an overwhelming threat if not accompanied by social advance. Translation of religion into practice by the mass of mankind could solve many of our troubles, but this can hardly be a sufficiently rapid rescue in our present emergencies. Man's most urgent problems are in the area of the social sciences. Their solution will not be speeded by trying to remold these sciences into the image of physics, chemistry, or biology. It may be aided by recognizing that the validity of scientific method is not confined to any one procedure, that methods now in use are open to critique and improvement, that methods developed in one field may presently find unsuspected utility in other fields, and that there may be new methods yet undiscovered.

EDGAR G. MILLER, JR.

Department of Biochemistry,
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Colloidal Electrolytes as a Class Inclusive of Polyelectrolytes, Chain Electrolytes, Long Chain Salts, Dyes, and Detergents

Colloidal electrolytes form one of the largest groups of colloids. In aqueous solution they exhibit properties of both colloids and electrolytes. The author suggested in 1912 (J. W. McBain, E. C. V. Cornish, and R. C. Bowden. *Trans. chem. Soc.*, 1912, 101, 2042) that this was due to the presence of both charged colloidal particles and ordinary ions. Typical examples were soaps and proteins. The former are association colloids whose particles or micelles are formed by association of ions; the latter are high polymers carrying dissociable groups that are exposed to the solvent.

This classification of colloidal electrolytes has long met with international acceptance, and an extensive literature on the subject has grown up, especially since the advent of synthetic detergents. As early as 1934 the Faraday Society organized an international symposium of over 400 pages on colloidal electrolytes, including such materials as cellulose, starch, proteins, gelatin, dyes, silicates, and a number of inorganic materials (*Trans. Faraday Soc.*, 1935, 31, 1-421).

Recently (*Science*, November 19, 1948, p. 545) the term "polyelectrolytes" was "coined to describe substances of high molecular weight which are simultaneously electrolytes." The new term was to include "the naturally-occurring polyelectrolytes such as proteins and

polysaccharides" and "synthetic materials." It was shown that polyelectrolytes are highly associated in solution. It was further suggested that "some of the problems of the biochemist will be reduced to special problems in a broader field—that of polyelectrolytes in general." However, these colloidal electrolytes, such as bile salts, have already received much attention both from physical chemists and biochemists, and their properties are just as closely related to the other colloidal electrolytes excluded in the quoted definition of "polyelectrolytes."

It would seem that the introduction of such a term would merely lead to confusion in this well established field. The term polyelectrolytes is not self-explanatory and might seem to refer to polyvalent electrolytes or to those that give rise to a variety of ions.

In a previous paper the term "chain electrolytes," which seems equally inapt, was coined (D. Edelson and R. M. Fuoss. *J. Amer. chem. Soc.*, 1948, 70, 2832). Another partial term is that of "long chain salts" (P. F. Grieger and C. A. Kraus. *J. Amer. chem. Soc.*, 1948, 70, 3808), which is also inadequate.

It now seems impossible to draw a sharp distinction between polymerization and association. Aluminum soaps are one instance of a borderline case. During the past year some authors have classified these as association colloids because their particle size or molecular weight depends upon concentration. Several other authors prefer to regard them as "polymers of high molecular weight formed by weak intermolecular links" such as hydrogen bonds. Both groups are describing the same facts.

It would seem advisable to retain the thoroughly established name "colloidal electrolytes" for all such materials, even if there are subgroups such as organic, inorganic, organic-inorganic, some that are purely products of association, and others that are simple polymers, or associated polymers, etc. A subgroup such as polyelectrolytes might be useful if it were sufficiently sharply and narrowly defined to include only one definite class of materials. The term "colloidal electrolytes" clearly includes them all and emphasizes their interrelatedness and common properties.

JAMES W. MCBAIN

Department of Chemistry,
Stanford University, California

Erratum

May I point out a confusing error that occurs in the last line of Table 1 in our recent short paper (H. H. Plough and Madelon R. Grimm, "Reversal to Penicillin Sensitivity in a Cysteine-requiring Mutant of *Salmonella*," *Science*, February 18, 1949, pp. 173-4). This should read: "S. D. alone - - - - -," that is, seven minus signs instead of one minus and six plus signs. I had to correct in galley an error of the original manuscript under a similar heading five lines above, and I assume that somehow the last line got shifted too.

H. H. PLOUGH

Department of Biology,
Amherst College, Amherst, Massachusetts

Book Reviews

The chemistry of high polymers. C. E. H. Bawn. New York: Interscience, 1948. Pp. + 249. (Illustrated.) \$4.50.

This is an excellent book and fills a real need in the field of polymer chemistry. While more advanced treatises on individual topics have appeared during the past few years, no other book has summarized the whole field of polymer chemistry so clearly and succinctly. The book is very readable and understandable but at the same time has neither sacrificed correctness nor oversimplified the problem.

The book is divided into the following seven chapters: Introduction: Nature and Types of Polymer; Condensation Polymerization; Addition Polymerization; Thermodynamics of Solutions of High Polymers; Size and Shape of Macromolecules; The Structure, Stereochemistry and Crystallinity of High Polymers; and Structure and Physical Properties of High Polymers. Each of these chapters is fairly complete and detailed, with the exception of the last, which is a rather brief outline of the physical properties of high polymers. Fairly extensive references to recent literature are included.

This book should be particularly valuable to the graduate student in chemistry who seeks a broad picture of the present status of polymer chemistry without the necessity of wading through four or five lengthy monographs on highly specific subjects. It also deserves a place on the bookshelves of research workers in the field of polymer chemistry.

TURNER ALFREY, JR.

Polytechnic Institute of Brooklyn

Les richesses de la mer: technologie biologique et océanographique. (Encyclopédie Biologique, XXIX.) Noël Boudarel. Paris, France: Paul Lechevalier, 1948. Pp. 548. (Illustrated.) 1,500 fr.

The information collected in this volume should prove immensely helpful to the more curious fishermen along the French coasts and provide a strong stimulus to those with a bent toward natural history. In addition to short chapters on the origins and development of oceanography, the characteristics of ocean water and bottom, and the common terrestrial plants found along the seashore, there

are more extended and profusely illustrated accounts on the algae, mollusks, fish, fish nets and traps, and fisheries. Other groups of marine life receive less full treatment, the criterion for inclusion often being their economic value or relationship to the fishing industry. Each kind of organism is treated under its scientific name, with common names furnished as well as distribution and a general verbal description. Interspersed are many comments on the uses to which the animal is put.

The illustrations are apparently all from original drawings. All are line cuts, and the printer has done well by them. Those of fishing scenes and gear are drawn in good perspective, but they may surprise readers used to halftone illustrations. The lack of halftones is noticed so quickly that one might suppose the book to have been written before the days of photography. The text, however, seems up to date. There is a short bibliography and a good index.

LORUS J. and MARGERY J. MILNE

University of New Hampshire

Psychology. William James. (Introduction by Ralph Barton Perry.) Cleveland-New York: World Publ., 1948. Pp. xxi+478. (Illustrated.) \$1.25.

The reviewer does not know which power of ten to use, but certainly hundreds of living scientists date their interest in psychology from the time they first read James' *Briefer course*. Many will be interested to learn that this renowned text has been reprinted in The Living Library series under the general editorship of Carl Van Doren. No one is better qualified than Ralph Barton Perry to write an introduction to the volume. He refrains from giving us James as "the founder of modern psychology" but is certainly on safe grounds in claiming him as "one of the first to extend the methods and spirit of modern science to the human mind." James' well-known special contributions to psychology, his formulation of the maxims of habit, theory of emotions, and the doctrine of "the stream of consciousness," appeared in his *Principles of psychology*, published in 1890, and were incorporated in chapters in his *Briefer course*, published in 1892. But there was more to James than "special contributions." As later developments have revealed, he succeeded in organizing and expanding the psychology of the past so as to influence strongly subsequent psychology at many points. Prof. Perry briefly traces the reasons why James is considered the originator of "functional psychology," a father of Gestalt psychology, why he markedly influenced abnormal psychology, as well as guidance, educational, and religious psychology. Also, Prof. Perry in his introduction explodes the widely accepted tradition that James was first a psychologist, and later a philosopher.

In James' preface to this text he answers some criticisms of the arrangement of the chapters in his *Principles of psychology*. It seems evident from a footnote, which is a part of the original preface, that he gave much thought to the arrangement of the chapter topics; he was not altogether happy in placing the subject of Sensation

first. Further he says: "I feel now (when it is too late for the change to be made) that the chapters on the Production of Motion, on Instinct, and on Motion ought, for purposes of teaching, to follow immediately upon that on Habit, and that the chapter on Reasoning ought to come in very early, perhaps immediately after that upon the Self. I advise teachers to adopt this modified order, in spite of the fact that with the change of place of 'Reasoning' there ought properly to go a slight amount of re-writing."

It has often been forgotten that all of James' chapters except one were written for the textbook, not first for magazine publication, which was only an afterthought and resorted to "because the completion of the whole work seemed so distant."

The words "Briefer Course" appear only on the jacket. The original 66 diagrams are all reproduced in the present edition. The print is clear and beautifully legible, the paper is good, the volume is neat and of a convenient size, (lighter weight than the old one), and there is a 10-page index. Pleasure mixed with nostalgia arises from turning these familiar pages.

WALTER R. MILES

Yale University School of Medicine

Organic reactions. (Vol. IV.) Roger Adams. (Ed.-in-Chief.) New York: John Wiley; London: Chapman & Hall, 1948. Pp. viii+428. (Illustrated.) \$6.00.

This is the fourth volume of a series started in 1942 the general purpose of which was clearly set forth in the *Journal of the American Chemical Society*, 1942, 64, 3062. The following eight subjects are discussed in an authoritative manner by authors who have had experience with the reactions they are describing: The Diels-Alder Reaction With Maleic Anhydride, by Milton C. Kloetzel (59 pp.); The Diels-Alder Reaction: Ethylenic and Acetylenic Dienophiles, by H. L. Holmes (114 pp.); The Preparation of Amines by Reductive Alkylation, by William S. Emerson (82 pp.); The Acyloins, by S. M. McElvain (13 pp.); The Synthesis of Benzoin, by Walter S. Ide and Johannes S. Buck (36 pp.); The Synthesis of Benzoquinones by Oxidation, by James Cason (57 pp.); The Rosemund Reduction of Acid Chlorides to Aldehydes, by Erich Mosettig and Ralph Mazingo (16 pp.); The Wolff-Kishner Reduction, by David Todd (45 pp.).

Organic chemists will enthusiastically welcome this latest addition to the series. Certainly the remarkable reception given to the first three volumes will be accorded this one also; for the chapters have been carefully prepared and edited and the publisher has again assembled them in a very handy form and in the most attractive manner possible. Although there may be some who will quibble over possible inconsistencies in the nomenclature of the many individual compounds listed at the end of the various chapters and also may observe the omission of one or two references here and there, it is the opinion of this reviewer that the same high

standards as set for the previous volumes have been maintained and that again all chemists are indebted to the several authors for their thorough covering of the sub-

ject and for their clear writing and excellent presentation.

Princeton University

EVERETT S. WALLIS

Scientific Book Register

BALDWIN, RALPH B. *The face of the moon*. Chicago: Univ. Chicago Press, 1949. Pp. xiv + 239. (Illustrated.) \$5.00.

BLACKETT, P. M. S. *Fear, war, and the bomb: military and political consequences of atomic energy*. New York: Whittlesey House, 1949. Pp. vii + 244. \$3.50.

BROWN, THOMAS B. *Foundations of modern physics*. (2nd ed.) New York: John Wiley; London: Chapman & Hall, 1949. Pp. xvi + 391. (Illustrated.) \$5.00.

COMMITTEE ON DIETETICS, MAYO CLINIC. *Diet Manual*. Philadelphia-London: W. B. Saunders, 1949. Pp. xiii + 329. (Illustrated.)

EGE, VILH. *Chauliodus Schn., Bathypelagic genus of fishes: a systematic, phylogenetic and geographical study*. (The Carlsberg Foundation's Oceanographic Expedition Round the World 1928-30 and Previous "Dana" Expeditions, No. 31.) Copenhagen: C. A. Reitzels; London: Oxford Univ. Press, 1948. Pp. 148. (Illustrated.) 32 Danish Kr. 1£ 13/.

FLORKIN, MARCEL. *Biochemical evolution*. New York: Academic Press, 1949. Pp. vi + 157. (Illustrated.) \$4.00.

FREAR, DONALD E. H. *A catalogue of insecticides and fungicides: chemical fungicides and plant insecticides, Vol. II*. Waltham, Mass.: Chronica Botanica, 1948. Pp. x + 153. \$5.50.

HAUBER, U. A. *Essentials of zoology*. New York: Appleton-Century-Crofts, 1949. Pp. x + 394. (Illustrated.) \$4.00.

MAVOR, JAMES WATT. *A brief biology*. New York: Macmillan, 1949. Pp. viii + 427. (Illustrated.) \$4.00.

MELONEY, FRANK LAMONT. *Clinical aspects and treatment of surgical infections*. Philadelphia-London: W. B. Saunders, 1949. Pp. xiii + 840. (Illustrated.) \$12.00.

POLUNIN, NICHOLAS. (Ed.) *Botany of the Canadian Eastern Arctic: Thallophyta and Bryophyta*. (Part II). (National Museum of Canada, Bull. 97.) Ottawa: Dept. Mines and Resources, 1947. Pp. iv + 573. (Illustrated.) \$1.00.

ROMANOFF, ALEXIS L., and ROMANOFF, ANASTASIA J. *The avian egg*. New York: John Wiley; London: Chapman & Hall, 1949. Pp. xiii + 918. (Illustrated.) \$14.00.

Association Affairs

Southwestern Division, AAAS. Frank E. E. Germann, executive secretary-treasurer, has written members of the Division that plans for the Alpine meeting on May 1-5 are already far advanced. Sul Ross State Teachers College, Alpine, Texas and the McDonald Observatory will be joint hosts at the meeting and twelve local committees have been appointed to look after everything from trips to Old Mexico to a free barbeque, which will replace the annual banquet. Members are asked to bring camping clothes instead of formal dress. Abstracts of papers to be presented should be in the hands of section secretaries before April 1.

The 1949 officers of the Division are R. A. Studhalter, Texas Technological College, president; Ernst Anteys, Globe, Arizona, vice president; and Frank E. E. Germann,

University of Colorado, secretary-treasurer. Elected members of the Executive Committee include W. M. Craig (1949), Lubbock; Edna L. Johnson (1950), Boulder; H. P. Mera (1950), Santa Fe; F. H. Douglas (1951), Denver; and O. B. Muench (1951), Las Vegas. Section chairmen and secretaries are, respectively: *Biological Sciences*—Fred W. Emerson, New Mexico Highlands University, and L. C. Hinckley, Sul Ross State Teachers College; *Mathematical Sciences*—Earl Walden, New Mexico College of Agriculture and Mechanic Arts, and B. D. Roberts, New Mexico Highlands University; *Physical Sciences*—A. R. Ronzio, Colorado State College, and J. A. Hancock, Texas College of Mines; *Social Sciences*—E. K. Reed, National Park Service, Santa Fe, and Edward Ferdon, Museum of New Mexico, Santa Fe.

NEWS and Notes

National Science Foundation. The six National Science Foundation bills before the Public Health, Science, and Commerce Subcommittee of the House Interstate and Foreign Commerce Committee will receive early attention, according to a statement made March 10 by Congressman J. Percy Priest, subcommittee chairman. The order of the bills' hearing, he said, was to be decided in an executive session of the subcommittee on March 16.

Congressman Priest plans to urge that the Foundation bills be placed high on the priority list as legislation which already has had considerable discussion and can be quickly disposed of. He expects that brief hearings will be held in order to acquaint new committee members with the issues involved. He urged that all interested individuals and organizations make their views known to the committee at or before the hearings. He mentioned that the only opposition to pending bills he knew of was coming from small manufacturers, particularly in the West, who apparently have been informed that patent policies will be altered to the detriment of the small businessman and inventor. The source of this story seems to have been "Invention News and Views," released by the National Patent Counsel. In November 1948, it carried a news item and an editorial attacking the proposed Foundation legislation as containing "provisions that would supply almost unlimited development of a bureaucracy authorized to meddle into the most intimate and critical social relations of the citizens as well as to threaten seriously to disturb the orderly development of our interests." It is interesting that manufacturers, rather than scientists, should be advising Congressmen on legislation of this type.

The members of the Public Health, Science and Commerce Subcommittee who have the responsibility for this legislation are: *Democrats*—J. Percy Priest, Tennessee, chairman; George C. Sadowski, Michigan; Thomas B. Stanley, Virginia; William T. Grana-

han, Pennsylvania; A. J. Biemiller, Wisconsin; and George H. Wilson, Oklahoma; *Republicans*—J. P. O'Hara, Minnesota; Wilson D. Gillette, Pennsylvania; Hugh D. Scott, Jr., Pennsylvania; and John B. Bennett, Michigan.

In the Senate, there has been no new action since S.247 was reported out by the Labor and Public Welfare Committee last week (Senate Report No. 90). On March 10 the bill had not yet been placed on the calendar. The filibuster and its after effects may seriously delay final Senate action.

HOWARD A. MEYERHOFF

About People

Britton Chance, former associate professor of biophysics at the University of Pennsylvania School of Medicine, has been appointed director of the Eldridge Reeves Johnson Foundation for Medical Physics at the University's Medical School. Dr. Chance will replace **Detlev W. Bronk**, who became president of Johns Hopkins University last January.

William B. Allington has been appointed chairman of the Department of Plant Pathology at the University of Nebraska. He succeeds **Robert W. Goss**, who will remain as plant pathologist and professor of Plant Pathology, and dean of the Graduate College.

J. C. Hackleman, Illinois College of Agriculture agronomist, was recently honored at a banquet attended by 200 Illinois seed growers who presented him with a cash award in appreciation of his 30 years' work with them. He plans to make a six-month tour of 20 states to study seed improvement work.

R. Ruggles Gates has been appointed an honorary president of the Seventh International Botanical Congress, to be held in Sweden in 1950. Dr. Ruggles is emeritus professor of botany at the University of London, and research fellow in biology at Harvard University.

William Stephenson, director of the Institute of Experimental Psychology, Oxford University, was among the 49 new members recently inducted into the University of Chicago chapter of Sigma Xi. Others were **George Buchi**, Baden Switzerland; **Andrew Fono**,

Stockholm; **Rayson Lisung Huang**, Kowloon, Hong Kong; **Augusto Segre**, Rome; **Cesare Emiliani**, Bologna, Italy; and **George T. E. Graham**, Rosetown, Saskatchewan.

Donald W. Pritchard, formerly of the Oceanographic Section of the U. S. Navy Electronics Laboratory, has been appointed director of the Chesapeake Bay Institute, a division of Johns Hopkins University.

Frances Drouet, curator of cryptogamic botany, Chicago Natural History Museum, has returned to his post after three and a half months of botanical exploration on the northeastern coast of the Gulf of Mexico. Dr. Drouet collected about 13,000 specimens of seaweeds, algae, and other plants which will be used for research purposes in the Museum's cryptogamic herbarium.

Alexander Petrunkevitch, professor emeritus of zoology, Yale University, will leave the U. S. March 24, to visit the museums of Great Britain and Continental Europe. His objective is the study and redescription of fossil types of Arachnida. The work, which will take several months, is sponsored by the American Philosophical Society and the Geological Society of America.

John R. Pellam, formerly with the Research Laboratory of Electronics at MIT, has been appointed to the staff of the National Bureau of Standards, where he will conduct research in the Cryogenics Laboratory. Other NBS appointments are: **William Piper**, former project engineer in the Office of Chief Signal Officer, Department of the Army, to the Ordnance Mechanics Laboratory of the Electronics Division; **John W. Utecht**, former chief engineer for the National Scientific Products Company, to the Ordnance Engineering Laboratory, and **Arthur E. Newlon**, formerly of the Stromberg-Carlson Company, to the Ordnance Research Laboratory of the Electronics Division.

James Gordon Cumming, Lt. Col. Medical Corps Reserve, U. S. Army, has retired as director of the Bureau of Preventable Disease, Washington, D. C. Health Department, after 24 years' service with the District government.

F. N. D. Kurie, former associate professor of physics, Washington University, St. Louis, will head the new Nucleonics Division of the Naval Research Laboratory, Washington, D. C. Other members of the Division include **M. H. Johnson**, **E. H. Krause**, **E. J. Schremp**, and **M. M. Shapiro**.

On May 1, **Sir Ben Lockspeiser** will succeed **Sir Edward Appleton** as secretary to the Committee of the Privy Council for Scientific and Industrial Research of Great Britain. Sir Ben is now chief scientist at the Ministry of Supply.

D. T. MacDougal, director and founder of the Desert Research Laboratory in Tucson, Arizona, branch of the Carnegie Institute of Washington, has been honored by the California Botanical Society, which dedicated to him an issue of its magazine, *Madroño*.

Robert A. Stauffer has been elected vice president and director of research of the National Research Corporation, Cambridge, Massachusetts. Mr. Stauffer has been associated with the company since 1942.

Visitors to U. S.

Olaug Somme, microbiologist at the University of Oslo, has been a visiting scientist in the Microbiology Division, Scripps Institution of Oceanography, University of California, La Jolla since last August and will visit biological stations on the East Coast before her return to Oslo.

Borg C. Christensen, of the Finsen Memorial Hospital of Copenhagen, Denmark, was a recent visitor at Argonne National Laboratory.

Grants and Awards

The American Petroleum Institute has granted \$19,500 to the Microbiology Division, Scripps Institution of Oceanography, University of California, in La Jolla, for continuation of research involving the role of microorganisms in the formation and transformation of petroleum. The present staff includes **Claude E. Zobell**, director, **Frederick D. Sisler**, **Joseph Q. Heplar**, **Carl H. Oppenheimer**, and **Margaret Knight**.

Iowa State College has received a grant of \$18,000 from the **Rockefeller Foundation** for research in genetics under the direction of **J. W. Gowen**, head of the genetics department. This is the fourth grant that the College has received from the Foundation for work in genetics.

The 1948 recipients of the \$1,000 **Borden Awards** administered by professional and scientific associations have been announced as follows: American Academy of Pediatrics: **Dorothy H. Andersen**, assistant professor in pathology, Columbia University, and assistant pathologist and attending pediatrician, Babies Hospital and Vanderbilt Clinic; American Institute of Nutrition: **Charles A. Carey**, chief of Division of Nutrition and Physiology, Bureau of Dairy Industry, U. S. Department of Agriculture; American Dairy Science Association: **Walter L. Gaines**, professor of Milk Production, University of Illinois; American Chemical Society: **Barbour L. Herrington**, professor of Dairy Chemistry, Cornell University, and chemist, New York Agricultural Experiment Station; Poultry Science Association: **William R. Hinshaw**, professor of veterinary science, University of California, veterinarian, California Agricultural Experiment Station; American Dairy Science Association: **Egerton G. Hood**, chief, Dairy Research, Division of Bacteriology and Dairy Research, Science Service, Dominion Department of Agriculture, Canada.

The Washington Academy of Sciences presented Certificates of Award to three scientists on March 17: to **Robert J. Huebner**, National Institutes of Health, in recognition of his contributions to knowledge of the transmission of certain rickettsial diseases; to **Maxwell K. Goldstein**, Naval Research Laboratory, for his distinguished research and development in the field of electronic engineering; and to **James A. Van Allen**, Applied Physics Laboratory, Johns Hopkins University, for distinguished service in nuclear physics and cosmic rays. Certificates of Merit for demonstrated talent were presented to seven local high school seniors.

The John and Mary R. Markle Foundation has selected its second group of **Scholars in Medical Science** from candidates nominated by accredited medical schools in the U. S. and Canada (see *Science*, August 20, 1948). The program, begun in 1948, is designed to aid young men and women planning careers in academic medicine. Appropriation of \$325,000 for their support will be allotted in grants of \$25,000 each at a rate of \$5,000 a year to the medical schools in which they now hold faculty appointments. The 13 Scholars and the medical colleges nominating them are: **Francis P. Chinard**, Johns Hopkins University School of Medicine; **Don W. Fawcett**, Harvard Medical School; **Allan V. N. Goodyer**, Yale University School of Medicine; **John B. Graham**, University of North Carolina School of Medicine; **John D. Green**, Wayne University College of Medicine; **George Watson James III**, Medical College of Virginia; **Ralph Jones, Jr.**, University of Pennsylvania School of Medicine; **George E. Moore**, University of Minnesota Medical School; **C. Barber Mueller**, Washington University School of Medicine; **George W. Schwert, Jr.**, Duke University School of Medicine; **Beverly T. Towery**, Vanderbilt University School of Medicine; **W. Clarke Wescoe**, Cornell University Medical College; and **Donald R. Wilson**, University of Alberta Faculty of Medicine.

Summer Programs

Harvard University will offer a summer program on "Science in General Education at the College Level," to be conducted by **James B. Conant**, president of the University, assisted by **Earl J. McGrath**, University of Chicago, **Fletcher Watson**, of the Harvard Graduate School of Education, and **Duane Roller**, Wabash College, Crawfordsville, Indiana. Inquiries concerning the course may be addressed to Summer School Office, Wadsworth House, Harvard University, Cambridge 38, Massachusetts.

The Tissue Culture Commission will sponsor a summer course from July 5-30 in the laboratory of the **Mary Imogene Bassett Hospital**, Cooperstown, New York. The program, dealing with the principles, methods, and applications of tissue

culture, will be under the direction of John H. Hanks. Applications should be sent to Mary S. Parshley, College of Physicians and Surgeons, 630 West 168th Street, New York City, before May 1.

The School of Library Service of Columbia University will offer a course in medical library literature and administration July 5-August 12. Courses in science literature, advanced information services, biology and physiology are also scheduled. Further information may be obtained from Estelle Brodman, School of Library Service, Columbia University, New York City 27.

Industrial Laboratories

The Western Division of the American Council of Commercial Laboratories will hold its annual meeting March 26, in the offices of Abbot A. Hanks, Inc., San Francisco. Roger W. Truesdail, president of Truesdail Laboratories, Inc., Los Angeles, is chairman of the Western Division, and Herbert D. Imrie, president of Abbot A. Hanks, Inc., is vice president.

A mercury vapor turbine-generator, built by General Electric, has been installed in the Hartford (Connecticut), Electric Light Company's South Meadow Station. Capable of producing 15,000 kilowatts of electricity, the new power plant uses mercury vapor instead of steam to drive the turbine, which in turn drives an electric generator and also supplies extra heat to produce steam for other turbine-generators.

A group of postdoctoral fellowships in the natural sciences, supported by **Merck and Company, Ltd., of Canada**, has been announced by the Research Council of Canada. These fellowships, ranging in value from \$2,500 to \$5,000, are available to qualified Canadian citizens with a doctorate degree in chemistry or biology for study in selected institutions in Canada and abroad. Information and applications must be received by the Merck Fellowship Board, National Research Council of Canada, Ottawa, before April 1.

The Perkin-Elmer Corporation,

Glenbrook, Connecticut, announces the development of a new infrared analyzer for continuous automatic analysis of as many as six different components in a flowing stream of sample. The stream may be either in the liquid or gas phase. Cycling time for a six-component analysis is about six minutes. The instrument provides a permanent and accurate record of product concentration and purity, as well as an immediate indication warning of process troubles.

A new \$2,500 graduate fellowship in analytical chemistry, supported by **Merck and Company, Rahway, New Jersey**, has been announced by the American Chemical Company. The fellowship is offered for 1949-50, with possible renewal for two years following. Applications must be received not later than May 1 by the American Chemical Society Fellowship Committee, 1155 16th Street, N.W., Washington 6, D. C.

A color computer which can distinguish 100,000,000 colors—ten times as many as the human eye can see—has been developed by H. R. Davidson, research physicist of General Aniline and Film Corporation of New York City, and engineered by D. W. Imm, of Librascope, Inc., Burbank, California. The computer, called the **Tri-stimulus Integrator**, was designed for use with the General Electric Spectrophotometer, invented by Arthur C. Hardy, of the Massachusetts Institute of Technology. Together, the two instruments analyze colors mathematically so that if one color does not match another the difference can be defined unambiguously.

Meetings and Elections

Methods to prevent conflicting dates of world meetings on medical science and pure and applied biology will be discussed at a council in Brussels, April 4-9. Fifty-four international associations, leagues, committees, and congresses are joining in the council. J. Maisin, general secretary of the International Union Against Cancer, will be chairman of the new coordination committee, and arrangements for the meeting are being made by I. M. Zhukova, head of the Medical Sciences Division of Unesco in Paris.

Kirtley F. Mather, professor of geology, Harvard University, will deliver the **1949 Westbrook Lecture Course**, April 14, 21, and 28 at 8:00 p.m. at the Wagner Free Institute of Science, Montgomery Avenue and 17th Street, Philadelphia. His subject will be "Earth's Resources and Man's Needs." The public is invited.

The American Pharmaceutical Association will hold its annual convention April 24-30 in Jacksonville, Florida. Six affiliated organizations meeting in Jacksonville the same week are: The American Association of Colleges of Pharmacy, National Association of Boards of Pharmacy, the Conference of the Pharmaceutical Association Secretaries, the American Society of Hospital Pharmacists, the American College of Apothecaries, and the American Institute of the History of Pharmacy.

The American Psychopathological Association will hold its annual meeting at the Commodore Hotel in New York City, June 3 and 4. Four sessions will be held, on the clinical, psychological, physiological, sociological, and anthropological aspects of anxiety.

The first annual meeting of the **International Cancer Research Commission**, formed in St. Louis last year (*Science*, November 21, 1947, pp. 479-483), has been tentatively scheduled for July 15-22 in Paris. Further information may be obtained from Ignacio Millan, Chairman, Avenida Veracruz 69, Mexico, D. F. The Commission, which originally consisted of one representative from each of 40 nations, has since been joined by Finland, Iceland, Israel, and New Zealand. Negotiations are under way for Dr. Kinoshita to be appointed as an observer for Japan.

Transactions of the Fourth International Cancer Research Congress (September 2-7, 1947), are being published in five parts, according to an announcement by E. V. Cowdry, president of the Congress. The first part, consisting of 267 pages, including illustrations, tables, and brief summaries of all papers in English, French, German, Italian, Russian, and Spanish, appeared in 1948 as No. 1, Vol. 6 of *ACTA* (Union Internationale Contre le Cancer). The other four parts of

the *Transactions* will soon be available. Cost of the complete set will be \$25 (\$5 for each part), and postal money orders for subscriptions should be sent to J. H. Maisin, Editor, 61 Voer des Capucins, Louvain, Belgium. Reprints of the separate papers can also be obtained from him.

The Council of the National Institute of Sciences of India recently elected the following Honorary Fellows: Louis de Broglie, professor of theoretical physics, Poincaré Institute, Paris University; Hans von Euler, professor emeritus of chemistry, Stockholm University; Harlow Shapley, director of Harvard Observatory, Harvard University; and Georg Tischler, Botanical Institute, Kiel University.

Deaths

Floyd Carlton Dockeray, 69, professor of psychology at Ohio State University and former professor at Ohio Wesleyan University, died January 15.

Friedrich Schneider, plant breeder associated with Rabbethge and Giesecke, seed breeders of Einbeck, Germany, died January 31 after a short illness.

Felix d'Herelle, 75, Canadian biologist and laboratory chief of the Pasteur Institute from 1914 to 1921, died February 22 in Paris. From 1928 to 1934 Prof. d'Herelle had served as professor of protobiology at Yale University.

James Rowland Angell, 79, president of Yale University for 16 years, died at his home in Hamden, Connecticut on March 4. Starting as assistant professor of psychology at the University of Chicago in 1894, Dr. Angell was acting president by the last year of his quarter-century there. After his retirement as president of Yale in 1937, Dr. Angell had been associated with the National Broadcasting Company as educational director.

Cosmic ray studies by Cornell University physicists are being carried on in a water tunnel drilled through 193 feet of solid rock more

than a century ago by Ezra Cornell who, thirty years later, founded Cornell University. The limestone above the tunnel acts as a filter and only mesons—the most powerful of the cosmic ray particles—reach the automatic recording equipment within the tunnel. The experiments are being conducted by Donald E. Hudson, and Giuseppe Cocconi, researchers in the Laboratory of Nuclear Studies, who are using Geiger counters, an ionization chamber, and other equipment to measure the intensity of the mesons.

The current Progress Report of Brookhaven National Laboratory (BNL-AS-1), which combines the administrative and scientific progress for the period July 1–December 31, 1948, is now available. Requests for this report should be directed to the Information Group, Information and Publications Division, Brookhaven National Laboratory, Upton, New York.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago 16, has submitted the following list of wanted chemicals: 1,3-dihydroxyanthraquinone; hydroxypyruvic acid; n-triacontanol; carboxymethylamine hemihydrochloride; glucose monocarbonate; dibromogermane; neomenthol; 3,5-diiodothyronine; chavicine; 9-ketostearic acid; p-menthane; carene; vanillyl amine; d-pantoyltauryl-p-chloroanilide; sylvestrene; thymidine; n-docosanal; sphingomyelin; trichlorogermane; and tungsten oxide tetrafluoride.

"Fishes of the Western North Atlantic" has recently been published by the Sears Foundation for Marine Research at Yale University's Bingham Oceanographic Laboratory. The 576-page study is the first of a series designed to present in one complete account the results of scientific advances of the past 50 years in the field of ichthyology. The volume is devoted to the most primitive forms of fishes: the lancelets, lampreys and hagfishes, and sharks.

Radioisotopes of cobalt, gold, and carbon are among the 50-odd elements heretofore sold by the U. S. Atomic Energy Commission that will now be made available without charge to approved cancer research workers. Up to this time only iodine, phosphorus,

and sodium have been provided free. The only cost to qualified applicants will be \$10 per shipment—which will cover packaging, monitoring, and bookkeeping—plus the cost of transportation. Allocation of the free isotopes will be made for studies involving animal subjects, research on basic cellular metabolism of cancerous cells, and experimental programs in evaluation of radioactive materials in therapy. Distribution is administered by the Isotopes Division, U. S. Atomic Energy Commission, Oak Ridge, Tennessee and interested investigators should address inquiries there.

Friends and pupils of the late professor Sir D'Arcy Thompson have formed a committee to establish permanent commemoration of him and have inaugurated a D'Arcy Thompson Commemoration Fund for the purpose. The committee proposes to have a replica painted of the oil portrait given by Lady D'Arcy Thompson to the Department of Natural History in the United College and to present the replica to University College, Dundee, where Sir D'Arcy was professor for 33 years. It also proposes to have Alfred Forrest's clay model of Sir D'Arcy cast in bronze for presentation to the University of St. Andrews. Any further information with regard to the plan will be supplied by Dr. R. R. Burt (Secretary to the Committee), Department of Natural History, The University, St. Andrews, Scotland.

A Special Notice to Any Prospective Exhibitor in the Annual Science Exposition of the 116th Meeting of the AAAS New York City, December 26–31, 1949

If you did not receive a letter inviting your participation in this year's annual Exposition, and if you would like to receive the Official Floor Plan and Booth Rental Information on the release date this month, please write at once to: R. L. Taylor, Assistant Administrative Secretary, AAAS, 1515 Massachusetts Avenue, N.W., Washington 5, D. C.